1941, No. 4 NOVEMBER 21

COPEIA

Established in 1913

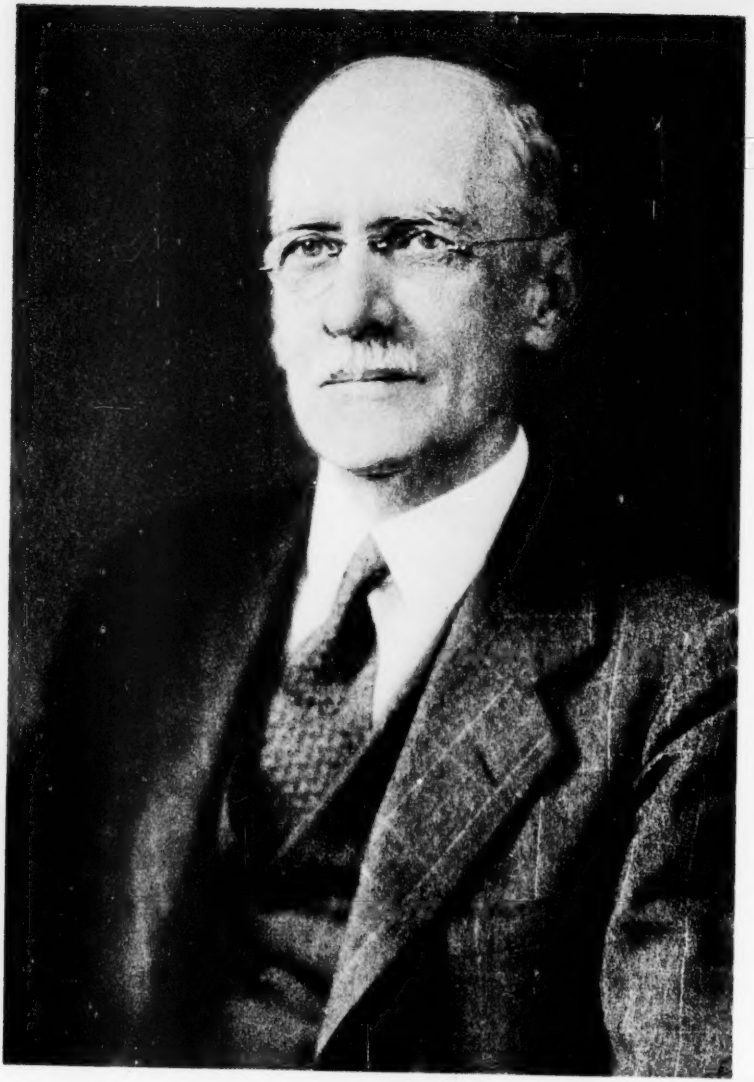
The Hugh McCormick Smith
Memorial Number

PUBLISHED BY
THE AMERICAN SOCIETY OF ICHTHYOLOGISTS
AND HERPETOLOGISTS

Copeia 1941, No. 4 November 21

CONTENTS

Published quarterly by the American Society of Ichthyologists and Herpetologists, at the Museum of Zoology, University of Michigan, Ann Arbor, Michigan, under the Act of August 24, 1912. Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized February 11, 1924.



DR. HUGH McCORMICK SMITH
1865–1941

To Hugh McCormick Smith

BACK in the spring of 1884 a young Washington bird enthusiast following the inspiration of his kind nature and desire to be of assistance took pity on the ignorance of a recently arrived foreign ornithologist who had cast his lot with the Smithsonian Institution then under Spencer F. Baird. Well acquainted with the feathered tribes of the Old World, the newcomer was unfamiliar with the bird life of his new home, but young Dr. Smith eagerly remedied this and in the old horse-and-buggy way took him through the recesses of the wonderful Rock Creek Valley, where a friendship sprang up which after more than half a century lost none of its affection, as the bird love lost none of its enthusiasm in spite of the fact that the one turned ichthyologist and the other herpetologist. Our interests met again in our professional careers in the problems connected with the northern fur seals, thus covering the same field as our beloved mentor Professor Baird, the outstanding mammalogist, ornithologist, herpetologist and ichthyologist of his time.

When Dr. Smith in 1886 joined the U. S. Fish Commission, the connection with the Smithsonian Institution, with Baird as the head of both, was in many respects so close that it sometimes was difficult to draw the line between them, and when in 1935 the Institution took Smith to its heart as Associate Curator of Zoology, he was practically at home again.

As U. S. Commissioner of Fisheries Dr. Smith was Baird's worthiest successor, for he possessed in rich measure the same mental and spiritual qualities that inspired in all his associates, high and low, the respect, faith, admiration and love of which this note is only a feeble expression. In my heart two pictures stand side by side, Spencer Fullerton Baird and Hugh McCormick Smith; higher tribute I cannot conceive.

LEONHARD STEJNEGER

Hugh McCormick Smith

By Leonard P. Schultz

DURING my embryonic and post-larval stages of development as an ichthyologist, the name of Dr. Hugh McCormick Smith was familiar to me as an outstanding authority in fisheries, because at that time his name appeared on popular and scientific articles indicating that he was U. S. Commissioner of Fisheries. Little did I realize then that I would have the privilege and honor, two decades later, to study fishes and share the same laboratories and office rooms with such an eminent and internationally known and highly honored scientist. It is my intention in this memorial number of Copeia to review certain aspects of Dr. Smith's life and contributions to science.

Hugh M. Smith at age of four years.

Dr. Smith came from one of the oldest families in Washington, as he represented the fifth generation born in the District of Columbia and his grandchildren the seventh. He was born November 21, 1865, near 5th and M Streets, N.W. His mother, a Hazard of Virginia, was born on a farm adjoining "Wakefield," where George Washington started life. His father, Thomas Croggon Smith, was a well-known and much loved physician in Washington from his graduation in 1864 to his death in 1913. The real name of the family may be said to be Howard—not Smith—because the grandparent, five generations previous to Dr. H. M. Smith, when a small boy, started from England in a sailing ship with his parents, Mr. and Mrs. Howard. On the way both died and the boy was cared for by fellow passengers named Smith, who settled in Maryland where they brought him up and he became known by his foster parents' name.

Dr. H. M. Smith began his natural history studies when he was a small boy, owing largely to his father's interest in the birds, snakes, and other small animals on his farm in Virginia. Several hundred of these specimens, collected before Smith was 18 years of age, were still in his possession. During Smith's attendance at Central High School, D.C., he was made first president of the Natural History Society which he helped organize and while in this office obtained specimens and display cases from Prof. Spencer Fullerton Baird. Upon graduating in 1884 he secured work in the bird department of the United States National Museum under Mr. Robert Ridgeway, Curator of Birds. Later he was transferred to the Library and on January 1, 1886, to

the U.S. Fish Commission. He entered the fishery service under Prof. Baird, who was always his ideal of a man and scientist and Smith was closely associated with memorials to that great man: the boulder and plaque at the Woods Hole fisheries station; the bronze tablet in the U.S. Bureau of Fisheries offices (now the Fish and Wildlife Service); and the portrait bust in the Hall of Fame of the American Museum of Natural History in New York City. When the latter was unveiled in 1906, he gave the dedicatory address.

In 1888 Hugh M. Smith graduated in medicine with a perfect record in all oral and written examinations. That summer he studied in several hospitals in New York, and in the autumn joined the staff of Georgetown University Medical School where he was first assistant professor then finally professor, having taught anatomy, histology, pathology and physiology until 1905. He then decided to stay in the fisheries service because of his increasing interest in the work. His medical training was useful all through his life, especially on his travels in the country districts of Siam where the people in the dense jungles, suffering from malarial fever, infections, and other diseases, came to him for treatment.

While in high school in 1882, he met a classmate, Emma Hanford,[1] whose parents had recently moved to Washington from Scottsville in western New York and they were married on March 12, 1889. Their daughters are Mrs. Edmund Vincent Cowdry, of St. Louis, and Mrs. Carl Harry Claudy, Jr., of Washington. While his family was growing up, he bought in 1906 a place in the foothills of the Bull Run Mountains, on which was an old log cabin. This was made livable, a porch and two rooms were added, whitewashed inside and out. There he spent many happy days for years, as the 125 acres became a sanctuary for all living things from copperheads to hummingbirds.

Hugh M. Smith at age of twelve years.

Another place greatly loved by Dr. Smith was Woods Hole, Massachusetts, for there he found much of interest biologically, saw his old friends and made new ones. Many of his friends from India, Siam, Japan, China and the European countries visited him there and in Washington. Especially cordial were the relationships between him and the employees of the former Bureau of Fisheries all over the United States as was indicated in many letters to him, one of which was written by the Superintendent of the Woods Hole Station, February 10, 1922, at the time Dr. Smith resigned from the Fisheries Service:

[1] To Mrs. Hugh M. Smith and Mrs. Janet E. Claudy, his daughter, I owe gratitude for a considerable amount of the information presented here.

It is with deep regret that we learn that you have resigned from this Bureau and at this time I wish to express my gratitude for your many kindly acts while at Woods Hole during the past seven years. As a rule, one does not look forward with pleasure to a visit from the boss especially if he is to remain on and work for several weeks. Here, your visits have been looked forward to with pleasure, I think, because the MAN was so much larger than the boss, this, notwithstanding the fact that the boss is one of the greatest in his class.

Sincerely,
[Signed] W. H. Thomas
Supt.

The first extensive trip to a foreign country occurred in 1903 when Dr. Smith spent six months in Japan. While there he studied fisheries industries all over the country, even going 65 miles from a railroad—there were no automobiles then. He was received everywhere with enthusiasm and kindness and was the first foreigner to visit the pearl-oyster farm of Mikimoto as guest of the proprietor. Among his Japanese friends were the leaders in science of a past generation, a few of whom were Mitsukuri; Kishinouye; Matsubara and Kitahara. Other extensive field investigations were made in the Philippines and later in Siam; from the latter country he returned in 1935, when he began monographing the freshwater fishes of Siam (Thailand).

The importance of Dr. Smith's lifework in natural history may be gained from the positions held by him and briefly tabulated below:

1884–1885 Worked in the National Museum.

1886 Entered service of U. S. Fish Commission under Comm. Baird.

1887–1893 Six promotions under commissioners Baird, Goode, and McDonald.

1888–1905 Medical faculty Georgetown University.

1891–1892 Co-special agent of 11th census in charge of fisheries.

1893 Representative of the United States at the World's Fishery Congress, Chicago, and Chairman, Section of Commercial Fisheries, World's Fisheries Congress.

1893–1897 Assistant in charge, division of statistics and methods of the fisheries.

1897–1903 Assistant in charge, division of inquiry respecting food fishes and the fishing grounds.

1898 Secretary, National Fishery Congress.

1900 Representative of the U.S. at the First International Fishery Congress, Paris.

1901–1902 Director, Marine Biological Laboratory of Bureau of Fisheries, Woods Hole, Massachusetts.

1903–1913 Deputy Commissioner, a position specially created by Congress.

1904 Chairman International Jury on Fish Culture, Louisiana Purchase Exposition.

1905 Representative of the U.S. at the Third International Fishery Congress, Vienna.

1906–1913 Expert adviser of Food and Drugs Board and of Bureau of Chemistry in fishery cases arising under the pure food and drugs act.

1907–1910 Director of "Albatross" expedition for investigation of fisheries and aquatic resources of the Philippine Islands.

1908 Representative of the U.S. as Secretary-General at the Fourth International Fishery Congress, Washington.

1910 Expert special assistant of the U.S. Counsel at the arbitration of the North Atlantic Fisheries Dispute at the Hague.

1910 Named by U. S. Government as its member of international commission for adjudication of fishery disputes with Canada and Newfoundland arising under the award of The Hague arbitration tribunal.

1912 Representative of the U.S. Government on the Permanent International Council for the Exploration of the Sea.

1909–1919 Member research committee National Geographic Society and associate editor National Geographic Society.

1914 Commissioner on behalf of the U.S. on International fishery commission for regulation of fisheries in boundary waters of the United States and Canada.

1918 Technical member, American-Canadian Fishery Conference.

1913–1922 Commissioner of Fisheries, U.S. Bureau of Fisheries.

1923–1935 Adviser in Fisheries to His Siamese Majesty's Government, organizer of the Siamese fishery service and first director of the fishery bureau.

1935-1941 Associate Curator in Zoology, Smithsonian Institution.

In recognition of Dr. Smith's services and achievements the following medals were presented to him:

1898 Fishery Exposition, Bergen, Norway. Gold medal for exhibits of artificially grown commercial sponges.

1898 Trans-Mississippi and International Exposition, Omaha. For services in preparing exhibit of the Bureau of Fisheries.

1908 Imperial and Royal Austrian Fishery Society. Silver medal awarded "Für Verdienste un die Föderungdes Fischereiwesens."

1912 Deutscher Fischerei Verein. Silver medal awarded "Für Verdienste un die Fischerei."

1925 Jubilee of King Rama VI of Siam. Bronze commemorative medal marking completion of 15th year of reign. Presented (intended and required) to be worn at court functions.

1926 Coronation of King Prajabipok (Siam). Bronze commemorative medal intended to be worn at court functions.

1931 Cruise of the Danish Research Vessel "Dana," 1928, 1929, 1930, under direction of Dr. Johannes Schmidt. Commemorative medal presented by the director. While the "Dana" was at Bangkok, Dr. Smith was a guest on board, presiding at the meeting of the Siam Society at which Dr. Schmidt lectured.

Dr. Hugh M. Smith in the court costume required to be worn in the presence of the King of Siam, Bangkok, 1930

Dr. Smith visited 22 foreign countries [2] for purposes of studying their aquatic resources and their fisheries as well as inspecting their methods of fish culture, their laboratories, biological investigations and fishery administration.

The extensive collections made in these various lands and the adjoining seas by Dr. Smith were given to various museums and have been studied by numerous investigators.

In honor of Smith's contributions to science the following animals [3] and plants bear his name:

BIRDS

Ramphalcyon capensis smithi Mearns. Kingfisher. Philippines.
Pellorneum ruficeps smithi Riley. Babbler. Siam.
Niltava smithi Riley. Flycatcher. Siam.
Abroscopus albogularis hugonis Deignan. Warbler. Siam.

[2] Argentina; Austria; Belgium; Burma; Canada; China; Denmark; England; France; Germany; Holland; India; Indo-china; Italy; Japan; Malaya; Norway; Philippines; Scotland; Siam; Switzerland; Uruguay.

[3] In addition to this list two new fishes and a new lizard, named after Dr. Smith, are published in this number of COPEIA.

REPTILES

Callophis hughi Cochran. Snake. Siam.
Riopa hughi Cochran. Skink. Siam.

AMPHIBIANS

Bufo smithi Stejneger. Toad. Japan.

FISHES

Ceratichthys smithi Evermann and Cox. Minnow. South Dakota.
Halieutichthys smithi Evermann and Marsh. Batfish. Puerto Rico.
Scopelosaurus smithi Bean. Deep-sea fish. South Atlantic Ocean.
Monhoplichthys smithi Fowler. Flathead. Philippines.
Coelorhynchus smithi Gilbert and Hubbs. Grenadier. Philippines.
Pomacentrus smithi Fowler and Bean. Demoiselle. Philippines.
Homaloptera smithi Hora. Loach. Siam.
Phenacostethus smithi Myers. Phallostethid. Siam.
Sigmistes smithi Schultz. Sculpin. Alaska.

MOLLUSKS

Lima (*Callolima*) *smithi* Bartsch. Marine bivalve. Philippines.
Bankia (*Nausitora*) *smithi* Bartsch. Shipworm. Siam.
Rhiostoma smithi Bartsch. Land snail. Siam.

CRUSTACEANS

Psopheticus hughi Rathbun. Crab. Philippines.
Caecidotea smithi Ulrich. Blind isopod. Subterranean stream, Texas.

INSECT

Milichiella smithi Aldrich. Fly. Siam.

CRINOID

Charitometra smithi Clark. Philippines.

MEDUSA

Lobonema smithi Mayor. Philippines.

PLANT

Sarcanthus smithianus Kerr. Orchid. French Indo-China.

Like other noted ichthyologists of this country, Dr. Hugh M. Smith began his publications on animals other than fishes. His first paper on "The Coon" appeared in 1884 in *Pastime* followed by two papers on birds in the same year and others in the *Auk* in 1885. After publishing 8 contributions on birds from 1885 to 1888, his first fisheries paper on the American Sardine Industry under the authorship of Edward R. Earll and Hugh M. Smith appeared in 1899. Until about 1905 he wrote mostly on statistics of fisheries, fish culture, fishing methods, or on habits of fishes of economic importance.

Although a minor paper appeared in 1893 his first definite ichthyological contribution occurred in 1894 when he described two new white fishes, *Coregonus osmeriformis* and *Coregonus prognathus*. Two years later the "Whitefishes of North America" appeared under the pen of Barton W. Evermann and Hugh M. Smith. Dr. W. C. Kendall and Dr. Smith published notes on Atlantic coast fishes in 1894 and later two papers with Theodore Gill appeared, indicating that these two noted men were influencing, inspiring and aiding him in his early ichthyological investigations, and thus it is concluded that his career as an ichthyologist began about 1893 and continued for 48 years.

His interest in the fauna of the vicinity of Woods Hole appeared in print first in *Science* and then in the *Bulletin of the U. S. Fish Commission*, in 1898,

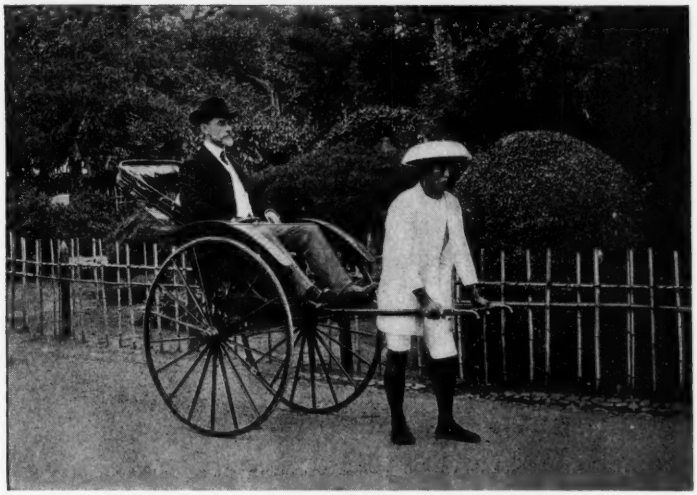


Fig. 1. Dr. Hugh M. Smith in Tokyo, Japan, 1903.

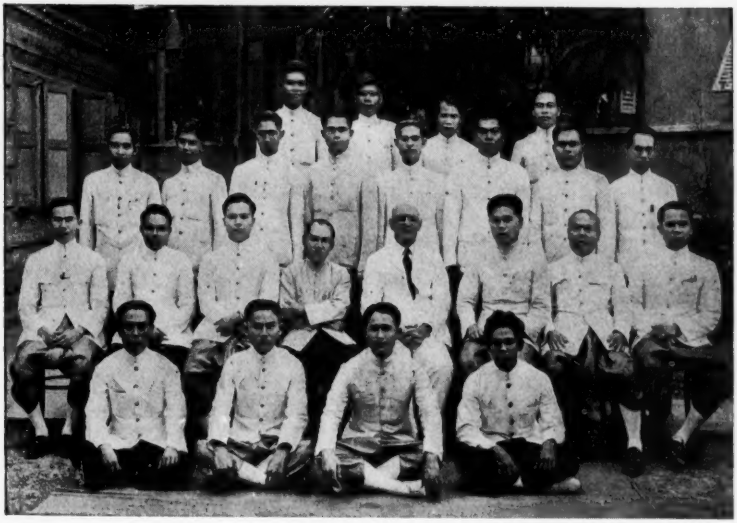


Fig. 2. Dr. Hugh M. Smith and his office staff of the Siamese Bureau of Fisheries at Bangok, Siam, 1930.

and continued until his death: the most recent contribution was his report in 1940 of a remora, *Phtheirichthys lineatus,* from there.

During the first few years of the 1900's Smith was so busily occupied in the Fish Commission with various economic aspects of commercial fisheries that only occasionally did he find time to work on the purely non-economic phases of fisheries science. His trips to Japan (Fig. 1) and Europe during these years and other duties in the District of Columbia completely filled his days, but in spite of this there appeared in 1906 two very important contributions, one with Alvin Seale and the other with T. E. B. Pope, and in both papers numerous new species of fishes were described. The paper with Mr. Pope indicates that Smith's ichthyological interests and knowledge had expanded to the far side of the Pacific Ocean, where soon he was to organize and help direct an expedition that brought back to the National Museum one of the greatest collections of fishes ever to be received in North America. Although the number of natural history specimens has never been accurately counted, reliable estimates of only the Philippine fishes collected from 1907 to 1910 by the "Albatross" indicate about 400,000 specimens. Practically all ichthyologists in the United States from that date to the present have written papers on this extensive collection and still hundreds of specimens await their first examination. However, from 1911 to 1917 several papers on the "Albatross" Philippine fishes appeared under his authorship.

In 1907 Smith's "Fishes of North Carolina" was printed. This book (453 + xii pages, 186 text figures and 21 plates) is a monument to his ability and versatility. After 33 years of trial this excellently compiled monograph with considerable original information on the marine and freshwater fishes of North Carolina is the only publication available for the identification of the fishes of that region.

The year 1923, after leaving the United States Fish Commission and embarking upon the next important phase of his life as Expert Adviser in Fisheries to the King of Siam, we find no printed contributions. However, in 1924, his scientific observations began to appear in print again and have continued each year uninterrupted up to the present.

His twelve years in Siam gave him the opportunity to collect fishes throughout that country and as a result he described a great number of new species and new genera.

As might be expected from his early training, his interests were not confined entirely to fishes for he collected plants, birds, insects, mollusks, crustaceans, mammals, amphibians, reptiles, and practically every living organism that he could. Much of this material was sent to the National Museum and has formed the subject matter for many hundreds of printed pages. Smith published on crabs, copepods, wild dogs, reptiles, birds, white elephants and algae while in Siam. When there, he organized the Bureau of Fisheries of Siam and brought to that country the modern idea of fisheries research. As long as Siam, now Thailand, has an interest in fish and fisheries science, the Siamese will praise Dr. Hugh M. Smith as its founder and laud him as a great benefactor to their country for his aid in developing their fisheries.

Dr. Smith's interest in Siamese fishes was so great that upon his return to the United States he began the most important ichthyological contribution

of his life, "A Monograph of the Freshwater Fishes of Siam." For the last six years this monumental work occupied a large part of his attention in the National Museum, where most of his Siamese fishes were deposited. It was my great good fortune to watch this manuscript develop during the past few years and to become acquainted with one of the finest men that I have known. Although he was entertained by royalty in Europe and Siam, traveled widely, and published extensively in nearly all fields of natural history, yet he was the same good, generous, kind and thoughtful friend who, when he was a little boy, said sympathetically to his mother, when they were caught in a downpour of rain and their clothes thoroughly drenched, "Mamma, never mind, the rain will make us grow." And grow he did, for he became a great leader in fisheries and an authority in ichthyology.

The following is a list of nearly all the published writings of Dr. Hugh M. Smith.[4] The publications with an * have not been checked with the original for accuracy of citation.

1884 The coon: Critical remarks, concluding with a moral. *The Pastime*, 3 (3): 18–19.
Notes on the birds found on Cobb's Island, Va., between July 9 and July 29, 1884. Pt. I—Land Birds. *Ibid.*, 3 (4): 31.
Pt. II—Water Birds. *Ibid.*, 3 (5): 37–38.

1885 Guano bird's egg. *Ibid.*, 3 (7): 10.
The distribution of seeds by the wind. *Ibid.*, 3 (8): 1–5.
The breeding of *Loxia americana* in the District of Columbia. *Auk*, 2: 379–380.
Ereunetes occidentalis on the lower Potomac. *Ibid.*, 2: 385.
Harelda glacialis in Maryland in summer. *Ibid.*, 2: 385.

1886 Birds new to the District of Columbia. *Ibid.*, 3: 139–140.
Peculiar nest of *Chelidon erythrogaster*. *Ibid.*, 3: 278.
The red phalarope in the District of Columbia—a correction. *Ibid.*, 3: 484.

1887 The range of *Quiscalus major*. *Ibid.*, 4: 346.

1888 *With* WILLIAM PALMER. Additions to the avifauna of Washington and vicinity. *Ibid.*, 5: 147–148.
With R. EDWARD EARLL. The American sardine industry in 1886. *Bull. U.S. Fish Comm.* 7, 1887: 161–192.

1890 *Fishing in the lower Potomac. *Forest and Stream*, 35: 458, 3 figs.

1891 Notes on the crab fishery of Crisfield, Maryland. *Bull U.S. Fish Comm.*, 9, 1889: 103–112, pls. 36–41.
Notes on an improved form of oyster tongs. *Ibid.*, 9, 1889: 161–163, pl. 44.
The giant scallop fishery of Maine. *Ibid.*, 9, 1889: 313–335, pls. 112–116.
Notes on the king-crab fishery of Delaware Bay. *Ibid.*, 9, 1889: 363–370, pls. 122–123.
On the disappearance of the dick cissel (*Spiza americana*) from the District of Columbia. *Proc. U.S. Nat. Mus.* 13: 171–172.
With MERWIN-MARIE SNELL. Review of the fisheries of the Great Lakes in 1885. *Rept. U.S. Fish Comm.*, 15, 1887: 3–334, 64 pls., maps.

1892 Notes on a collection of fishes from the lower Potomac River, Maryland. *Bull. U.S. Fish Comm.*, 10, 1890: 63–72, pls. 18–20.
Report on an investigation of the fisheries of Lake Ontario. *Ibid.*, 10: 177–215, pls. 21–50.
With J. W. COLLINS. Report on the fisheries of the New England states. *Ibid.*, 10: 73–176.
With J. W. COLLINS. A statistical report on the fisheries of the Gulf States. *Ibid.*, 11: 93–184.
A nautical gladiator. Frank Leslie's Popular Monthly, N. Y., 33 (5): 600–605, illus.

1893 Report on a collection of fishes from the Albemarle region of North Carolina.

[4] I wish to thank Miss Hilda Schmaltz, secretary, Division of Fishes, U. S. National Museum for her aid in verifying many of the references cited.

Bull. U.S. Fish Comm., 11, 1891: 185–200.
Report on the fisheries of the South Atlantic States. *Ibid.*, 11, 1891: 271–356, pls. 43–74.
Fish acclimatization on the Pacific coast. *Sci.*, 22: 88–90.
Sharks in Lake Nicaragua. *Ibid.*, 22: 166–167.
Report on the inquiry regarding methods and statistics of the fisheries, for fiscal years 1889–90, 1890–91. *Rept. U.S. Fish Comm.* 1889–1891, 17: 173–204.

1894 The fyke nets and fyke-net fisheries of the United States, with notes on the fyke nets of other countries. *Bull. U.S. Fish Comm.*, 12, 1892: 298–355, pls. 72–91.
Economic and natural history notes on fishes of the northern coast of New Jersey. *Ibid.*, 12, 1892: 365–380.
Remarks on the maintenance and improvement of the American fisheries. *Ibid.*, 13, 1893: 287–292.
Statistics of the fisheries of the United States. *Ibid.*, 13, 1893: 389–417.
The fisheries of Japan. *Ibid.*, 13, 1893: 419–435.
Notes on two hitherto unrecognized species of American whitefishes. *Ibid.*, 14, 1894: 1–13, pl. 1.
Notes on the capture of Atlantic salmon at sea and in the coast water of the Eastern States. *Ibid.*, 14: 95–99, pls. 3–4.
Report on the division of methods and statistics of the fisheries, for fiscal year 1892. *Rept. U.S. Fish Comm.*, 18, 1892: cxxxiii–cxci.
Report on fisheries of the Great Lakes. *Ibid.*, 18, 1892: 361–462.
With W. C. KENDALL. Extension of the recorded range of certain marine and fresh-water fishes of the Atlantic coast of the United States. *Bull. U.S. Fish Comm.*, 14, 1894: 15–21.

1895 Mortality among white-bellied swallows in Florida. *Auk*, 12: 183–184.
Notes on a reconnaissance of the fisheries of the Pacific coast of the United States in 1894. *Bull U.S. Fish Comm.*, 14, 1894: 223–288.
A statistical report on the fisheries of the Middle Atlantic States. *Ibid.*, 14, 1894: 341–467.
Report of the division of statistics and methods of the fisheries, for fiscal year 1893. *Rept. U.S. Fish Comm.*, 19: 52–77.

1896 Notes on an investigation of the menhaden fishery in 1894, with special reference to the food-fishes taken. *Bull U.S. Fish Comm.*, 15, 1895: 285–302.
A review of the history and results of the attempts to acclimatize fish and other water animals in the Pacific States. *Ibid.*, 15, 1895: 379–472, pls. 73–83.
Report of the division of statistics and methods of the fisheries. *Rept. U.S. Fish Comm.*, 20, 1894: 115–175.
Report of the division of statistics and methods of the fisheries. *Ibid.*, 21, 1895: 93–123.
Notes on Biscayne Bay, Florida, with reference to its adaptability as the site of a marine hatching and experiment station. *Ibid.*, 21, 1895: 169–191.
With BARTON W. EVERMANN. The whitefishes of North America. *Ibid.*, 20, 1894: 283–324, pls. 11–28.

1898 The fishes found in the vicinity of Woods Hole. *Bull. U.S. Fish Comm.*, 17, 1897: 85–111, map and fig.
The salmon fishery of Penobscot Bay and River in 1895 and 1896. *Ibid.*, 17, 1897: 113–124, map and pl. 5.
The Florida commercial sponges. *Ibid.*, 17, 1897: 225–240, pls. 12–31.
On the occurrence of *Amphiuma*, the so-called congo snake, in Virginia. *Proc. U.S. Nat. Mus.*, 21: 379–380.
Statistics of the fisheries of the interior waters of the United States. *Rept. U.S. Fish Comm.*, 22, 1896: 489–574.
Report of the division of statistics and methods of the fisheries, for the fiscal year 1896. *Ibid.*, 22, 1896: 119–145.
Report on the division of scientific inquiry, for fiscal year 1897. *Ibid.*, 23, 1897: xci–cxxiv.
Report of the division of statistics and methods of the fisheries for the fiscal year 1897. *Ibid.*, 23, 1897: cxxv–cxlvi.

Biological survey of Lake Erie. *Sci.*, 8: 13–14.
Fishes new to the fauna of southern New England recently collected at Woods Hole. *Ibid.*, 8: 543–544.
Fish ova for educational purposes. *Ibid.*, 8: 671–672.
With WILLIAM C. KENDALL. Notes on the extension of the recorded range of certain fishes of the United States coasts. *Rept. U.S. Fish Comm.*, 22, 1896: 169–176.
1899 The southern spring mackerel fishery of the United States. *Bull U.S. Fish Comm.*, 18, 1898: 193–271.
Notice of a filefish new to the fauna of the United States. *Ibid.*, 18, 1898: 273–278, pl. 1, 2 figs.
The mussel fishery and pearl-button industry of the Mississippi River. *Ibid.*, 18: 289–314, pls. 65–85.
*A cancerous family. *Med. Rec.*, Feb. 25: 2 pp.
Deep-sea exploring expedition of the steamer *Albatross*. *Nat. Geog. Mag.*, 10: 291–296, 1 pl., 2 figs.
Report on the inquiry respecting food-fishes and the fishing-grounds. *Rept. U.S. Fish Comm.*, 24, 1898: cxxiii–cxlvi.
Notes on the extent and condition of the alewife fisheries of the United States in 1896. *Ibid.*, 24, 1898: 31–43.
*Acclimatization of Pacific salmon in the Great Lakes. *Revue Intern. Pêche et Piscicul. St. Petersburg*, Dec. (3): 9–10.
*Government fish-culture in the United States. *Ibid.*, Dec. (3): 10–11.
A new marine biological laboratory. *Sci.*, 9 (227): 658–659.
Exploring expedition to the Mid-Pacific Ocean. *Ibid.*, 9 (232): 796–798.
Fish fauna of the Woods Hole region. *Ibid.*, 10: 878–881.
Interesting fish [*Caranx lugubris*] from the Alabama coast. *Sci. Amer.*, Feb. 11: 90–91.
*The pearl-button industry of the Mississippi River. *Ibid.*, Aug. 5: 1–15, 7 figs.
*Fish of the District [of Columbia]. *Washington Post*, Nov. 13.
With BARTON A. BEAN. List of fishes known to inhabit the waters of the District of Columbia and vicinity. *Bull. U.S. Fish Comm.*, 18: 179–187.
1900 *Great improvements to come in fish culture. *Brooklyn Daily Eagle*, New York, Dec. 30.
Notes on the Florida sponge fishery in 1899. *Bull. U.S. Comm.*, 19: 149–151.
Report on the inquiry respecting food-fishes and the fishing-grounds. *Rept. U.S. Fish Comm.*, 25, 1899: cxix–cxlvi.
*The three-toothed lamprey. *Sci. Amer.*, April 14: 235, 2 figs.
With THEODORE GILL. Moringuoid eels in American waters. *Sci.*, 11 (286): 973–974.
1901 *Concerning the habits of salmon. *Astoria (Oregon) Daily Budget*, Sept. 2.
Snow bunting at sea. *Auk*, 18: 195.
The French sardine industry. *Bull. U.S. Fish Comm.*, 21: 1–26, pls. 1–8.
Addition to the fish fauna in 1900. [Contribution from the biological laboratory of the U.S. Fish Commission, Woods Hole, Massachusetts.] *Ibid.*, 21: 32.
Notes on the subtropical fishes observed in 1900. [Contribution from the biological laboratory of the U.S. Fish Commission, Woods Hole, Massachusetts.] *Ibid.*, 21: 32–33.
The French sardine industry. *The Fishing Gazette*, Oct. 12, 18: 641–642; Oct. 26, 18: 673–674.
*The French sardine industry. *Pop. Sci. Mon.*, 2: 542–556, 8 figs.
Report on the inquiry respecting food-fishes and the fishing-grounds. *Rept. U.S. Fish Comm.*, 26, 1900: 119–135.
Chiasmodon in the Indian Ocean. *Sci.*, 23 (326): 510–511.
1902 Das kleinste bekannte Wirbeltier. *Allgemeine Fisherei-Zeitung*: 224–226.
The king rail in winter near Washington, D.C. *Auk*, 19: 285.
A supposed new colony of least terns on Martha's Vineyard. *Ibid.*, 19: 76.
Description of a new species of blenny from Japan. *Bull U.S. Fish Comm.*, 21, 1901: 93–94, text fig.
Notes on five food fishes of Lake Buhi, Luzon, Philippine Islands. *Ibid.*, 21, 1901: 167–171, pl. 22, text figs.

Lampreys ascending falls. *St. Nicholas Mag.*, New York, July 20: 1 p., 1 fig.
Report on the inquiry respecting food-fishes and the fishing-grounds. *Rept. U.S. Fish Comm.*, 27, 1901: 111–140.
Notes on the tagging of four thousand adult cod at Woods Hole, Massachusetts. *Ibid.*, 27, 1901: 193–208.
Note on the Scotch method of smoking haddocks. *Ibid.*, 27, 1901: 269–271.
*Le plus petit vertébré connu. *Revue Scientifique*, 17: 345–346.
The smallest known vertebrate. *Sci.*, 15: 30–31.
Fishes and fisheries of the Irish Sea. By W. A. Herman and Robert A. Dawson. Review. *Ibid.*, 16: 305–306.
**With* Dean Sage, Charles H. Townsend and William C. Harris. Salmon and Trout. New York: x + 417, figs.

1903 The smallest pygmy among fishes. *St. Nicholas Mag.*, New York, June 30: 1, 2 figs.
Observations on the herring fisheries of England, Scotland, and Holland. *Bull. U.S. Fish Comm.*, 22: 1–16, 2 pls., text figs.
The largest bluefish. *Forest and Stream*, Oct., 61: 283.
Marine animals in interior waters. *Sci.*, 17 (420): 114.
Breeding habits of the yellow catfish. *Ibid.*, 17 (424): 243–244.
With Leighton G. Harron. Breeding habits of the yellow catfish. *Bull. U.S. Fish Comm.*, 22: 151–154.

1904 Zur Naturgeschichte der Regenbogenforelle. *Allgemeine Fischerei-Zeitung*: 169–170.
Salmon-marking experiments on the Pacific coast. *Amer. Fish Culturist*, 1 (3): 9–10.
Effects of the sun's rays on fish ova. *Ibid.*, 1 (4): 15.
A marked Japanese salmon. *Ibid.*, 1 (10): 23.
A St. Louis exhibit. The attractions of the government fishery display. *Evening Star*, Washington, D.C., June 25.
Another sea-serpent myth. *Forest and Stream*, New York, 63: 472. Also *Amer. Fish Culturist*, 2 (2): 5.
Fisheries of Japan. *Nat. Geog. Mag.*, 15: 362-364.
Description of a new species of blind eel of the genus *Anguilla*. *Proc. Biol. Soc. Wash.*, 17: 121–122, 1 fig. Also *Amer. Fish Culturist*, 1 (8): 11–12, 1 fig.
A new cottoid fish from Bering Sea. *Proc. Biol. Soc. Wash.*, 17: 163–164, 1 fig.
Report on the inquiry respecting food-fishes and fishing grounds, for fiscal year 1902. *Rept. U.S. Fish Comm.*, 28: 111–142.
The common names of the basses and sunfishes. *Ibid.*, 28: 353–366.
*The largest animals. *St. Nicholas Mag.*, New York, March: 1 p.
Brittany, the land of the sardine. *Ibid.*, 31: 963–968, figs.
"As flat as a flounder." *Ibid.*, 31: 1032–1034, figs.
A fish new to Florida waters. *Sci.*, 19: 314.
Notes on the breeding habits of the yellow-bellied terrapin. *Smithsonian Quart.*: 252–253.
Japan, the paramount fishing nation. *Trans. Amer. Fish. Soc.*, 9: 111–138, 17 figs. Also *Amer. Fish Culturist*, 2 (4, 5): 101–110; 1905: 141–151.

1905 The sea-weed industries of Japan. *Bull. U.S. Fish Comm.*, 24: 133–165, 4 plates, 26 figs.
The utilization of seaweeds in the United States. *Ibid.*, 24: 167–181, pl. 5, 7 figs.
The latest shark story. *Fishing Gazette*, New York, 22: 621.
The marking of artificially hatched salmon. *Forest and Stream*, New York, 64: 177, 4 figs. Also *Amer. Fish Culturist* 2 (1): 9–10, 4 figs.; and *Pacific Fisherman*, 3: 24–25.
Fisheries of Japan. *Nat. Geog. Mag.*, 16: 201–220, 13 illus.
*Promotion of fishery trade between the United States and Japan. *Pacific Fisherman*, 3: 8.
*The sardine. *Ibid.*, 3: 12–13.
Economic aspects of national fish-culture and acclimatization. *Rept. U.S. Fish Comm.*, 29, 1903: 14–18. Also *Forest and Stream*, 64: 217–218.

Report on inquiry respecting food-fishes and the fishing-grounds. *Rept. U.S. Fish Comm.*, 29, 1903: 75–100.
General account of the lobster and claim investigations. *Ibid.*, 29: 141–147.
Note regarding the promotion of the fishery trade between the United States and Japan. *Ibid.*, 29, 1904: 239–243.
The drumming of the drum-fishes (Sciaenidae). *Sci.*, 22: 376–378.
Note on a rare flying-fish (*Cypselurus lütkeni*). *Ibid.*, 22: 746.
The international congress of fisheries at Vienna, 1905. *Trans. Amer. Fish. Soc.*: 199–200.
Remarks on sponge cultivation. *Ibid.*: 256.
With THEODORE GILL. A new family of jugular acanthopterygians. *Proc. Biol. Soc. Wash.*, 18: 249–250, 1 fig.

1906 The failure of our shad fisheries. *Forest and Stream*, New York, 67: 17.
The international fishery congress, 1908. *Sci.*, 24 (602): 57–58.
Fishery legislation before the fifty-ninth Congress, first session. *Trans. Amer. Fish. Soc.*: 91–96.
With ALVIN SEALE. Notes on a collection of fishes from the Island of Mindanao, Philippine Archipelago, with descriptions of new genera and species. *Proc. Biol. Soc. Wash.*, 19: 73–82, 5 figs.
With THOMAS E. B. POPE. List of fishes collected in Japan in 1903, with descriptions of new genera and species. *Proc. U.S. Nat. Mus.*, 31: 459–499, 12 figs.

1907 Spencer Fullerton Baird. [Pioneers of American Science]. *Amer. Mus. Nat. Hist.*: 21–23.
Our fish immigrants. *Nat. Geog. Mag.*, 18: 382–400, 3 figs.
The fishes of North Carolina. *N.C. Geol. Econ. Surv.*, 2: i–xii, 1–453, 21 plates, 186 text figs.
Some observations on European fisheries and fish-culture. *Trans. Amer. Fish. Soc.*, 1907: 170–183.

1908 The United States Bureau of Fisheries, its establishment, functions, organization, resources, operations, and achievements. *Intern. Fish. Congress 1908, Washington:* 1–80, 2 plates, 43 text figs.
The transplanting of fish. What has been done by the fish commission. *Sci. Amer Suppl.* 66: 190–192.
Annual Address President Amer. Fish. Soc. *Trans. Amer. Fish. Soc.*: 71–74.

1909 *Japanese goldfish, their varieties and cultivation. Washington: 112 pp., 11 pls., numerous text figs.
Brittany: the land of the sardine. *Nat. Geog. Mag.*, 20: 541–573, 23 illus.
Some giant fishes of the seas. *Ibid.*, 20: 637–644, 6 illus.
King herring: an account of the world's most valuable fish, the industries it supports, and the part it has played in history. *Ibid.*, 20: 701–735, 21 illus.
*Case of epidemic carcinoma of the thyroid in fishes. *Wash. Med. Annals*, 3: 313.

1910 The United States Bureau of Fisheries: its establishment, functions, organizations, resources, operations, and achievements. *Bull. U.S. Bur. Fish.*, 28 (2): 1367–1411, pls. 148–156.
North Holland cheese market. *Nat. Geog. Mag.*, 21: 1051–1066, 17 illus.
Federal fish farming, or planting fish by the billion. *Ibid.*, 21: 418–446, 22 illus.

1911 Making the fur seal abundant. *Ibid.*, 22: 1139–1165, 18 illus., map.
Note on the occurrence of the whale shark (*Rhinodon typicus*) in the Philippine Islands. *Proc. Biol. Soc. Wash.*, 24: 97.
*The conservation of fishery resources. *Sci. Amer.*, 105: 149–154, figs.
The North Atlantic fisheries dispute and its arbitration at The Hague in 1910. *Trans. Amer. Fish. Soc.*: 405–414.
With LEWIS RADCLIFFE. Descriptions of three new fishes of the family Chaetodontidae from the Philippine Islands. *Proc. U.S. Nat. Mus.*, 40: 319–326, 3 figs.

1912 *Statement on behalf of the Department of Commerce and Labor and the Bureau of Fisheries regarding the trawl-net fishery. Hearings before the committee on the merchant marine and fisheries, House of Representatives, on H. R. 16457 prohibiting the importation and landing of fish caught by beam trawlers, May 28 and 29: 100–104.

Pearl fisheries of Ceylon. *Nat. Geog. Mag.*, 23: 173–194, 13 illus., 1 map.
America's most valuable fishes. *Ibid.*, 23: 494–514, 17 illus.
Description of a new notidanoid shark from the Philippine Islands representing a new family. *Proc. U.S. Nat. Mus.*, 41: 489–491, Pl. 42, 16 figs.
The squaloid sharks of the Philippine Archipelago, with descriptions of new genera and species. *Ibid.*, 41: 677–685, 5 pls. 4 figs.
The chimaeroid fishes of the Philippine Islands, with description of a new species. *Ibid.*, 42: 231–232, 1 pl.
The prolificness of *Gambusia*. *Sci.*, 36: 224.
Philippine sharks. *Ibid.*, 36: 902.
With LEWIS RADCLIFFE. Description of a new family of pediculate fishes from Celebes. *Ibid.*, 42: 579–581, 1 pl.

1913 *The story of the sturgeons. In J. C. Linthicum, Protection of our food fish. *Congressional Rec.*, Oct. 17: 13–14.
Oysters: the world's most valuable water crop. *Nat. Geog. Mag.*, 24: 257–281, 21 illus.
Mysterious life of the common eel. *Ibid.*, 24: 1140–1146, 3 illus.
The Hemiscylliid sharks of the Philippine Archipelago, with description of a new genus from the China Sea. *Proc. U.S. Nat. Mus.*, 45: 567–569, 1 pl. 2 figs.
Description of a new carcharioid shark from the Sulu Archipelago. *Ibid.*, 45: 599–601, 1 pl., 3 figs.

1914 *Pacific policy of the Bureau of Fisheries. *Pacific Fisherman*, 12: 7.
A file fish new to the fauna of the Atlantic coast of the United States. *Sci.*, 40: 815.
Address at the dedication of the new building of the Marine Biological Laboratory [at Woods Hole]. *Ibid.*, 40: 230–232.
Report of the United States Commissioner of fisheries for the fiscal year ending June 30, 1913. *Rept. U.S. Fish Comm.*: 1–78.
The need for a national institute for the technical instruction of fisherfolk. *Trans. Amer. Fish. Soc.*, 1913: 41–46.
*Commercial possibilities of the goose-fish: a neglected food; with 10 recipes. *U.S. Bur. Fish. Econ. Cir.*, No. 13.
Report of the United States Commissioner of Fisheries for the fiscal year ending June 30, 1914. *Rept. U.S. Fish Comm.*: 1–81.
Report of the United States Commissioner of Fisheries for the fiscal year ended June 30, 1915. *Ibid.*: 1–83.
Spencer Fullerton Baird. A bibliography. By William Healey Dall. Review. *Sci.*, 42: 425–428.
The relations of the federal government with the fishing industry of the Pacific coast. *Trans. Amer. Fish. Soc.* 1914: 23–28.

1916 Sharks, man-eaters and others, with suggestions that Americans turn to economic account some of the smaller species of the Atlantic coast. *Amer. Mus. Jour.*, 16: 341–355, figs.
Fisheries. *Amer. Yr. Bk.*, 1915: 477–479.
The United States Bureau of Fisheries and its relation to the United States Coast and Geodetic Survey. *Centenn. Celeb. U.S. Coast Geod. Surv.*, April 5–6 (1): 1–6.
The Bureau of Fisheries and its biological station at Beaufort, N.C. *Dept. Comm. U.S. Bur. Fish.*: 1–11.
America's Surpassing Fisheries: Their present condition and future prospects and how the federal government fosters them. *Nat. Geog. Mag.*, 29: 546–583, 35 figs.
Report of the United States Commissioner of Fisheries for the fiscal year ended June 30, 1916. *Rept. U.S. Fish Comm.*: 1–114.

1917 Fisheries. *Amer. Yr. Bk.*, 1916: 476–477.
New genera of deep-water gurnards (Peristediidae) from the Philippine Islands. *Proc. Biol. Soc. Wash.*, 30: 145–146.
Report of the United States Commissioner of Fisheries for the fiscal year ended June 30, 1917. *Rept. U.S. Fish Comm.*: 1–104.
The scientific work of the Bureau of Fisheries. *Sci.*, 45: 653–654.

1918 Fisheries. *Amer. Yr. Bk.*, 1917: 461–463.

The contributions of zoology to human welfare. *Sci.*, 47: 299–301.
Report of the United States Commissioner of Fisheries for the fiscal year ended June 30, 1918. *Rept. U.S. Fish Comm.*: 1–94.

1919 Fisheries. *Amer. Yr. Bk.*, 1918: 502–504.
Report of the United States Commissioner of Fisheries for the fiscal year ended June 30, 1919. *Rept. U.S. Fish Comm.*: 1–57.
Methods of securing better cooperation between government and laboratory zoologists in the solution of problems of general or national importance. *Sci.*, 50: 1–4.
*Fresh-water mussels. A valuable national resource without sufficient protection. *U.S. Bur. Fish. Econ. Cir.*, No. 43.

1920 Fisheries. *Amer. Yr. Bk.*, 1919: 504–506.
When the Father of Waters goes on a rampage: an account of the salvaging of food-fishes from the overflowed lands of the Mississippi River. *Nat. Geog. Mag.*, 37: 369–386, 18 illus.
Report of the United States Commissioner of Fisheries for the fiscal year ended June 30, 1920. *Rept. U.S. Fish Comm.*: 1–66.

1921 *Rudderfishes at Woods Hole in 1920. COPEIA (91): 9–10.
Report of the United States Commissioner of Fisheries for the fiscal year ended June 30, 1921. *Rept. U.S. Fish Comm.*: 1–50.
Address. *Trans. Amer. Fish Soc.*, 50, 1920: 30–32.
The Alaska fur seal: an international asset. *Ibid.*, 50, 1920: 83–91.
Some recent observations on the freshwater eel. *Ibid.*, 50, 1920: 297–300.
With WILLIAM C. KENDALL. Fishes of the Yellowstone National Park, with description of the park waters and notes on fishing. *Rept. U.S. Fish Comm.*, 1921: 1–30, figs. 1–16.

1922 Second occurrence of *Squatina* in New England. COPEIA (106): 33.
The Spencer Fullerton Baird memorial. *Sci.*, 50: 634–635.

1924 Goldfish and their cultivation in America. *Nat. Geog. Mag.*, 46: 375–400, 22 illus.

1925 A review of the aquatic resources and fisheries of Siam, with plans and recommendations for their administration, conservation, and development. Kingdom Siam, Minist. of Lands and Agric. Bangkok: 1–91. [Reprinted in Siamese.]
A whale shark (*Rhineodon*) in the Gulf of Siam. *Sci.*, 62: 438.
*Siam's fishery resources. *Mid-Pac. Mag.*, 29 (3). Honolulu.

1926 Aquatic resources and fisheries of Siam. *Bangkok Times*, Sept.: 1–9, 3 pls.
[Chapter on Fauna]: 39–40; 45–72, 2 pls. [*in* Natural Features of Siam]. Ministry of Commerce and Communications. Bangkok.
[Resources of Siam] fisheries. *The Record, the organ of the Bd. Commer. Develop.* April (20): 20–21, Bangkok.
A herd of wild elephants in Peninsular Siam. *Jour. Siam Soc. Nat Hist., Suppl.* 6 (4): 365–366.
A new bird from Siam. *Ibid., Suppl.* 6 (4): 366.
A fossil crab from Siam. *Ibid., Suppl.* 6 (4): 366–367.
Mysterious acoustic phenomena in Yellowstone National Park. *Sci.*, 63: 586–587.
* The fish of Siam. *Siam Observer.* Bangkok.

1927 The fighting-fish of Siam. COPEIA (159): 169–172.
The so-called musical sole of Siam. *Jour. Siam Soc. Nat. Hist., Suppl.* 7 (1): 49–54.
The Siamese fish *Puntius proctozysron* Bleeker. *Proc. Biol. Soc. Wash.*, 40: 195–196.
The fish *Neostethus* in Siam. *Sci.*, 65: 353–355.
The control of diabetes in Siam by the use of solanaceous plants. *Ibid.*, 66: 619–620.
Some fresh-water fishes of Siam. *Trans. Amer. Fish. Soc.*, 56, 1926: 213–226.
The Uruguayan fur-seal islands. *Zoologica*, 9 (6): 271–294, figs. 294–300.

1928 Second occurrence of a copepod parasite (*Argulus*) on fighting fish. *Jour. Siam Soc. Nat. Hist., Suppl.* 7 (3): 197.
Anguillid eels in Siamese waters. *Ibid., Suppl.* 7 (3): 194–195.
Wild dogs in Siam. *Ibid., Suppl.* 7 (3): 195–196.
New reptiles and batrachians collected by Dr. Hugh M. Smith in Siam. By Doris M. Cochran. Review. *Ibid., Suppl.* 7 (3): 198.

The birds of the Malay Peninsula. By Herbert C. Robinson. Review. *Ibid., Suppl.* 7 (3): 198–201.

1929 Notes on some Siamese fishes. *Ibid., Suppl.* 8 (1): 11–14.

1930 Large tusks in a Siamese elephant. *Ibid., Suppl.* 8 (2): 121–122.
The common birds of Bangkok. By C. J. Aagaard. Review. *Ibid., Suppl.* 8 (2): 123–124.
The reptilia and amphibia of the Malay Peninsula. *Ibid., Suppl.* 8 (2): 125–126.
Herpetological collections made in Siam from 1923 to 1929. By Doris M. Cochran. Review. *Ibid., Suppl.* 8 (2): 126–127.
[Chapter V—Fauna]: 41–42; 50–79, 2 pls. Chapter IX—Aquatic Resources and Fisheries: 163–172, 4 pls. [*in* Siam: Nature and Industry]. Ministry of Commerce and Communications. Bangkok.

1931 The osteoglossid fish *Scleropages* in Siam. COPEIA (2): 64.
A new name for a Siamese goby. *Ibid.,* (2): 64.
[Barbels in *Albulichthys*]. *Ibid.,* (3): 138.
Sikukia stejnegeri, a new genus and species of freshwater cyprinoid fishes from Siam. *Ibid.,* (3): 138–139.
Notes on Siamese fishes. *Jour. Siam Soc. Nat. Hist., Suppl.* 8 (3): 177–190.
Descriptions of new genera and species of Siamese fishes. *Proc. U.S. Nat. Mus.,* 79: 1–48, pl. 1, text figs. 1–22.

1932 The fighting-fish of Siam. *The Aquarium,* 1: 181–182.
Chorinemus vs. *Scomberoides.* COPEIA (3): 156.
The status of *Osphronemus saigonensis* Borodin. *Ibid.,* (4): 180.
Contributions to the ichthyology of Siam. I. *Jour. Siam Soc. Nat. Hist., Suppl.* 8 (4): 255–262, pl. 23.
Bulletin of the Raffles Museum, Singapore, Straits Settlements, No. 5, August 1931; No. 6, December 1931. Review. *Ibid., Suppl.* 8 (4): 344.

1933 Are there many kinds of Gourami? *The Aquarium,* 1: 276–277.
Ventral axillary scales in *Ambassis.* COPEIA (2): 103.
Zoological collecting in Siam in 1931 and 1932. *Explor. Field Work Smith. Inst.,* 1932: 29–32, 4 figs.
Contributions to the ichthyology of Siam. II to VI. *Jour. Siam Soc. Nat. Hist., Suppl.* 9 (1): 53–57, 3 pl., 4 figs.
An edible mountain stream alga. *Ibid., Suppl.* 9 (1): 143.
A poisonous horseshoe crab. *Ibid., Suppl.* 9 (1): 143–145.
Contribution to the ichthyology of Siam. VII, VIII. *Ibid., Suppl.* 9 (2): 245–260, pl. 8–9.

1934 Some Siamese aquarium fishes. *The Aquarium,* 3 (4): 80–82, 3 figs.
What the fisheries may offer as a vocation for Siamese youth. *Bangkok Times,* Jan. 20 (reprint: 1–14). [Lecture delivered before Y.M.C.A. of Bangkok, Jan. 12.]
Boy Scouts and the fishes of Siam. *Ibid.,* 54 (188): 2.
Zoological collecting in Siam. *Explor. Field Work Smith. Inst.,* 1933: 28–31, 4 figs.
Contributions to the ichthyology of Siam. IX–XIX. *Jour. Siam Soc. Nat. Hist., Suppl.* 9 (3): 287–325, pl. 10–14, text fig.
A new broadbill for Siam. *Ibid., Suppl.* 9 (3): 328.
The white oriole of Kao Sabop. *Ibid., Suppl.* 9 (3): 329.

1935 A new American record for the snipefish (*Macrorhamphosus*). COPEIA (2): 104.
Zoological collecting in Siam. *Explor. Field Work Smith. Inst.,* 1934: 29–32, 4 figs.
Synchronous flashing of fireflies. *Sci.,* 82: 151–152.

1936 A walking fish. *Nat. Hist.,* 38: 249–252, 1 pl., figs.
The archer fish. *Ibid.,* 38: 3–11, 3 pls., 3 figs.

1937 The fighting fish of Siam. *Nat. Hist.,* 39 (4): 264–269, 1 pl.
The fighting fish of Siam. *Sci. Digest,* Aug.: 7–10.
With ROBERT A. GOFFIN. A fish new to Massachusetts Bay [*Leiostomus xanthurus*]. COPEIA (4): 236.

1938 *Alectis crinitus,* a fish new to Massachusetts Bay. *Ibid.,* (3): 146–147.
Status of the oriental fish genus *Culter. Jour. Wash. Acad. Sci.,* 28: 407–411.
Chagunius, a new genus of oriental cyprinoid fishes. *Proc. Biol. Soc. Wash.,* 51:157–158.

Status of the oriental fish genera *Aplocheilus* and *Panchax*. *Ibid.*, 51: 165–166.

1939 The archer fish. *The Aquarium*, 8 (3): 37–41, 2 figs.

A new genus of clariid catfishes. COPEIA (4): 236.

With ROBERT A. GOFFIN. A stingray (*Dasyatis say*) new to New England. *Ibid.*, (4): 236–237.

1940 The remora *Phtheirichthys lineatus* and the first specimens from United States waters. *Jour. Wash. Acad. Sci.*, 30 (12): 531–533.

1941 The proper specific name for the oriental catfish usually called *Plotosus anguillaris* (Bloch). *Proc. Biol. Soc. Wash.*, 54: 15–16.

The gobies *Waitea* and *Mahidolia*. *Jour. Wash. Acad. Sci.*, 31: 409–415, figs. 1–2.

While this number of COPEIA was in page proof, Dr. Smith's family and his numerous friends in this and other countries, were shocked by his sudden death, on the morning of September 28, 1941, from an attack of coronary thrombosis. Through his death science has lost one of its great men, internationally known for his investigations in ichthyology and in fisheries as well as in general natural history. His kindliness and his willingness to help others with their problems had made him dear to the hearts of many, who now feel most keenly the loss of their friend.

U. S. NATIONAL MUSEUM, WASHINGTON, D.C.

Dr. Hugh M. Smith, Director of the Philippine Cruise of the "Albatross"

By PAUL BARTSCH

OF all the ships that have been devoted to biological explorations of the sea, none has surpassed the endeavors conducted on board the U. S. Bureau of Fisheries steamer "Albatross," during her 39 years of service from 1882 to 1921.

Among the many cruises made during her long career, none has yielded greater scientific results than her work in the waters of the Philippines and adjacent seas.

These achievements must be largely credited to Dr. Hugh M. Smith, upon whose shoulders rested not only the negotiations with the island government, but the planning of the cruise and the infinite details of equipment as well as the selection of the civilian staff.

The "Albatross" was manned by Naval Officers and normally carried a complement of 70 men. To gain the good will and cooperation of officers and men and keep this through long cruises when away from mail and civilized contact (radio was then unknown) requires unique leadership; to instill an interest in what is being done that will make staff and men forget not only the charms of Manila but the very hours of the day or night, requires that enthusiastic personality that I have met only in Hugh M. Smith.

The "Albatross" was commanded by Lt. Commander (later Rear Admiral) Marbury Johnston from September 25, 1907, to June 10, 1908, and Lt. Commander (later Rear Admiral) C. W. McCormick from June 10, 1908, to the end of the cruise. The civilian staff of the vessel consisted of the following:

Dr. Hugh M. Smith, Deputy Commissioner of Fisheries, Director of the Expedition
Mr. Frederick M. Chamberlain, Resident Naturalist
Mr. Lewis Radcliffe, General Assistant and Naturalist
Mr. H. C. Fassett, Fishery Expert
Dr. Paul Bartsch, Zoologist, representing the U. S. National Museum
Mr. Clarence M. Wells, Assistant and Clerk

The "Albatross" sailed from San Francisco October 16, 1907, and after spending ten days in Honolulu, two at Midway Island and two at the Island of Guam, reached Manila November 28, 1907.

During the two years following, the "Albatross" was actively engaged in making natural history surveys which covered not only the Philippine Archipelago, but the adjacent seas to the south.

Her first endeavors, while waiting for the major equipment from the United States, covered the region of Manila Bay and the western shore of the southern part of the Zambales Peninsula. The first extensive cruise began at Manila and extended south through the Philippine seas to the south coast of Mindanao, Sulu, Sulu Archipelago, to South Reef, the southernmost part of the islands, thence west to Sandakan, Borneo.

The second cruise was devoted to an exploration of the region embraced by the central group of islands, that is, Panay, Negros, Cebu, Bohol, Leyte, Samar, Masbate and Marinduque.

The third cruise was largely devoted to an exploration of the sea and shores of the eastern and southeastern coasts of Mindanao and also to work on the southeastern and eastern coasts of Mindoro.

The period from July to December, 1908, was devoted principally to an exploration of the China Sea, embracing dredgings off the coast of southern Luzon as well as the western rim of that body of water from Hong Kong to Formosa, including the Pratas Reef region. The region of the small islands known as the Batanes Group lying north of Luzon, was next subjected to an overhauling.

In December, 1908, and January, 1909, a cruise was made through the

Calamianes group lying between Mindoro and the northern part of Palawan; the western and southern part of Palawan, thence south to British North Borneo, and northward to Cagayan Sulu and Iloilo.

In February and March and early April of 1909, dredgings were made along the southern coast of Luzon and among the small islands extending from there to Bohol, the Cagayanes to the eastern coast of Palawan and northward to Cuyo Island.

In May, 1909, there was a cruise along the small islands north of Samar and the southeastern coast of Luzon.

July, August, and September, 1909, were devoted to work in the waters of Samar, the southeast coast of Leyte, and the north coast of Mindanao, then Bohol, Negros, Siquijor, and Cebu. The first half of September was used largely in dynamiting along the coast of Mindanao, southeast of Zamboanga, followed by another cruise through the Sulu Archipelago, which extended to Darvel Bay and Sibuko Bay, Borneo.

The last prolonged cruise was made during November and December, 1909, and January, 1910, and covered a part of the Dutch East Indies, including the gulfs of Tomini and Boni, Celebes, Molucca Passage, Patience Strait, Pitt Passage, Molucca Sea, Britain Strait, Flores Sea, and Macassar Strait.

January 21, 1910, saw the beginning of the homeward voyage, which included a stop-over at Nagasaki, Japan, for an overhauling of the ship. Her home port San Francisco was reached May 4, 1910.

It would be difficult to furnish at this time, or probably ever, a detailed account of the enormous collections made on this cruise. Of fish alone, there were about 400,000 specimens turned over to the U.S. National Museum. If one bears in mind that each of the larger fishes required injection and a number of changes of alcohol, one can gain somewhat of an idea of the amount of labor expended by the scientific staff upon each individual specimen. Then, too, it should be borne in mind that in every instance where feasible detailed color descriptions were made of the fish as soon after it was captured as possible, and an immense number of color sketches were prepared by the artist. It seems a pity that lack of funds makes it impossible to publish all of these pictures. Of mollusks, more than 89,000 lots were obtained, a lot embracing all specimens of one species obtained in one locality, which might be a single specimen or 10,000. Of bird skins, between 400 and 500 specimens were secured, among them several new species. Of reptiles 290 specimens were collected, as follows: frogs, 157; lizards, 60; snakes, 72; turtles, 1. To all of these must be added the immense groups of other invertebrates ranging from Protozoa to Arthropods.

The U. S. Bureau of Fisheries published "Dredging and Hydrographic Records of the U.S. Fisheries steamer 'Albatross' during the Philippine Expedition, 1907–1910," in 1910, which gives a detailed account of all the dredging stations and hydrographic stations occupied, including the position, chart, date, the time of day, the depth and character of the bottom, hourly water temperatures of surface, and bottom; density, surface and bottom; the type of apparatus used, the depth, the length of the trawl, the direction of the

trawl as well as the distance covered, with remarks as needed. Here also are indicated places where shore work, seining or dynamiting or reef-collection or poisoning were done. This record shows that 577 dredging stations were established, 220 of which were at less depth than 100 fathoms; 120 were made at between 100 and 200 fathoms, while 153 indicate a depth ranging from 200 to 499 fathoms; 72 were made between 500 and 999 fathoms, and 12 at over a thousand fathoms. Of deeper records there are recorded a station of 1804 fathoms in the China Sea off Formosa, another at 2275 fathoms in the Sulu Sea, and one of 1560 fathoms in the Molucca Sea.

It should be remembered that each of these dredging stations was preceeded by a sounding made by the use of the Lucas Sounding machine and Sigsbee Sounding rod and water bottle, as well as a bottom sampler, the depth record being necessary for the operation of the heavier gear to be used.

The collections after arriving in Washington were distributed to specialists for study and report and many publications have appeared in various scientific journals, such as the *Proceedings of the United States National Museum; Bulletin of the U. S. Bureau of Fisheries; Reports of the U. S. Fish Commission; Proceedings of the Biological Society of Washington; Journal of the Washington Academy of Sciences; The Auk; Nautilus; Smithsonian Miscellaneous Collections;* and perhaps others. All of the larger reports were gathered in a series known as *Bulletin 100 of the United States National Museum* of which 13 volumes have been published to date. In addition there are several long manuscripts awaiting publication as soon as funds are made available.

It was my intention to conclude this paper by citations from the three thick volumes of my Journal made during the cruise. For that purpose I have carefully read over that entire manuscript, which I find so uniformly interesting that it is practically impossible to select high spots for there was not a dull day from the beginning to the end. I can probably best convey the working picture by saying that during the entire cruise, when not actually at Manila as a base or at some of the larger cities where our sailors were given shore leave, we were constantly on the move, rarely spending more than a couple of days in a single place.

This gave us a wonderful contact with Philippine life in that day as we always came unannounced into the harbor serving for a night's anchorage. At daylight, after a cup of coffee and a bite in the galley, a boat would be put over-board and an effort made to enter some stream, if such were present, near our anchorage. On this trip collections would be made of fresh-water organisms when fresh water could be reached, as well as land animals, stressing birds, and among the plants, ferns. A vigorous blast of the siren if we failed to return to the ship by 8 A.M. would tell us that the ship was about to put to sea. The rest of the day up to about 5 o'clock would be spent in dredging operations, the number of dredge hauls varying with the depth of the water in which the work was being done, greater time being required for the deeper hauls. I have stated elsewhere what preliminary steps were taken with each haul before the dredge would yield its actual catch. The bottom sample taken during sounding would be saved as such, supplied with a tin

U. S. Bureau of Fisheries Steamer, "Albatross"

tag, and kept from decaying by the addition of alcohol. The returns of the haul would vary with the gear used.

An intermediate net haul contained no mud and would furnish us with free-swimming life, varying from Protozoa to fish.

Hauls with the reversible Tanner beam trawl were always accompanied by a mud bag dredge and at times would yield tons of bottom material. This was dropped into a huge hopper provided with screens of varying mesh and a canvas bottom, the sloping end of which had a sleeve under which a bobbinet bag would be suspended. The load being emptied, a hose was brought to play upon the catch and organism after organism, as it became revealed, would be extracted from the mud, washed, and set aside for further administration. The final catch of the haul would be the contents of the bobbi-net bag, the meshes of which were fine enough to hold the mass of foraminifera brought aboard.

Next would come the sorting of the catch and caring for all the elements captured. Small things, desired for color notes, would be put in the aquarium and kept for description when a suitable time arrived.

Shallow water work would mean hustling and not infrequently temporarily setting aside in tubs and other containers with suitable labels the catch for administration toward the end of the day—yea, this would often continue until the beginning of the morning. Every fish and every large specimen would be provided with a tin tag, lesser things placed in bottles similarly numbered, and all the numbers entered in a register with the necessary data. A considerable job for each haul.

If the day was not a strenuous one and time was available, when we entered a harbor toward evening, another boat would be put ashore and more work of the kind mentioned for the morning endeavor would be undertaken.

After dark the submarine light would be brought into play. This was an incandescent bulb enclosed in a water-tight glass capsule attached to a 200-foot water-tight cable. Upon being lowered and slowly raised to the surface, a cloud of microscopic life would gather about the globe like a haze. Soon larger forms would mingle with this, worms of various species, small crustaceans, larval eels, small fish and larger and larger forms. All of these would swim in a rotary motion about the globe, forming a veritable wheel of life, the larger forms preying upon the smaller. Occasionally schools of squid, those lightning creatures of the sea, or more slowly moving sea serpents or even a huge shark would appear in the outer confines of the light.

Fishing with a submarine light was always an attractive sport and at times kept us so interested that we would fish the night through, gathering plankton hour by hour into containers for eventual study in the laboratories of the east.

Among the several outstanding bright memories of this submarine light fishing is one of the rotary swimming of a non-stalked crinoid, slowly edging its way toward the light. We had not dreamed that crinoids were thus affected. Another is of a curious small fish, curious on account of its peculiar motion, which approached the light, and upon being deposited in our galvanized pan, proved to have immense prehensile extensions of the mem-

branes between the front spines of the dorsal fin, by means of which the fish was able to fasten himself to objects or tie these processes into what appeared to be a Gordian knot, only to release them at will.

On another occasion, when we dipped up an *Argyropelicus*, we found to our great surprise this curious animal was a combination of jet and translucent plastic, which glowed as if a miniature incandescent bulb was within its body; it was in the wee small hours that this fish came to the net, and I could not refrain from arousing everybody on board to see the wonder—even the Captain's slumbers were disturbed. The fact that I had not swung from the yard-arm next morning or been put in the brig, showed that the fish must have been interesting.

Whenever we were in harbor at low tide, we would seek reefs which were not difficult to find, for at every low tide the entire native village nearby would turn out to search for shellfish and other creatures used for food. By doing this we were able to add an endless number of specimens detected by the sharp eyes of the natives trained for such purposes, and which could be transferred to our bag by the expenditure of a few coppers. Then, too, when in harbor, seining parties would be dispatched to suitable ground and seines of various sizes used, while other members of the staff proceeded to dynamite the reef, thus securing material which could be obtained in no other way except by long time trapping, for the coral reef dwellers are so securely tucked away among the crevices that no dredge or other implement could possibly coax them forth. A blast of dynamite brought many of these to the surface, where they would fall an easy victim to the dip net and when the smoke cleared away many others would be found stretched out among the collapsed coral growth, easily available to our spears or dip nets.

I take the liberty of quoting from my Journal the result of one dynamiting endeavor in Port Galera, Mindoro:

Kinds	*Species*	*Kinds*	*Species*
Chaetodonts	15	Blennies	3
Heniochids	13	Labrids	11
Scarids	11	Apogonids	9
Zanclid	1	Balistid	1
Lethrinids	3	Tylosurid	1
Pomacentrids	21	Barracuda	1
Serranids	4	Mugilids	2
Acanthurids	4	Fistularid	1
Scorpaenid	1	Herrings	2
Holocentrids	2	Atherinids	2
Lutianids	7	Platycephalid	1
Carangid	1	Gobies	4
Surmullet	1	Cichlops	1
Eel	1		

Traps of various kinds were used in suitable localities where time would permit. In this way all the fishes present in the territory would receive an overhauling.

It fell to the duty of Mr. Fassett to secure from the Fisheries files or in communication with the natives all the data pertaining to the output of the Philippine fisheries as well as the equipment used in the securing thereof. This resulted in a great amount of statistics as well as descriptions and

photographs of equipment ranging from fish hooks to mazes of traps miles in extent.

In addition to these marine endeavors, we made inland trips whenever our ship came to anchor for a more prolonged period, thus while we were waiting for supplies at Manila shortly after our arrival in the Islands, I made a visit to Montalban, the locality immortalized by Möllendorff for mollusks. Next Dr. Smith and I made a trip up Pansipit River through Laguna de Bai to Santa Cruz and from there by carramata and pony through Santa Margarita, Majayjay, to the top of Botocan Falls, the most magnificent waterfall in the Philippines.

We could tell stories of land leeches and 13 months of rain a year and other high yarns as a result of this trip, but we were unable to explain how hemirhamphid fishes succeeded in reaching the upper side of this tremendous sheet of water.

Another trip took us to Taal Volcano where we had our first contact with wild chickens and megapodes. It should be recalled that this volcano blew up a few years later, killing a large portion of the population of the adjacent region.

Another memorable trip was our visit to the summer capital at Bagio. This Dr. Smith and I approached by carramata from Dagupan by way of Twin Peaks, through the marvelous Bued River Valley, passing from a palm and tree fern, moist, sizzling region to a temperate zone of pines with its nuthatches and chickadees.

After a short stay we concluded our expedition over a wonderful trail leading from the western rim of that most ancient crater from the edge of which could be seen range after range of mountains and away off in the distance, more than 30 miles, the beating of the surf on the fretted shores. This trail led us through Mr. Fox's place to Naguilian and San Fernando from whence we returned by boat to Dagupan and then by rail to Manila.

Still another unforgettable land trip was that made from Malabang to Lake Lanao, Mindanao, where we were under the escort of Major Portello who, every time I dismounted to pick up some specimens would stand over me with a cocked revolver, while the cavalry escort would come to attention. That was the condition produced by the Moro's response to the enforced regime at the time.

Volumes might be written about each of these trips. However, I feel that I have far exceeded the number of pages that have been allotted to me for this endeavor, and I shall therefore bring it to a close by stating that I am mindful of the old saying which refers to the establishment of friendships and which, as a test, suggests taking a man camping and winds up with the assurance that if he stands that test that you will love him forever, and if he fails you will hate him as genuinely. I wish to say for Hugh M. Smith that I did not hate him!

U. S. National Museum, Washington, D.C.

Hugh McCormick Smith and the Bureau of Fisheries

By Samuel F. Hildebrand

DR. HUGH McCORMICK SMITH, who was Commissioner of Fisheries from 1913 to 1922, had the unique distinction of serving under all his predecessors in office, having been appointed a clerk in the Division of Statistics in the United States Fish Commission (changed to the United States Bureau of Fisheries in 1903) on January 1, 1886, under the first Commissioner, Prof. Spencer F. Baird. After serving in various subordinate grades he was appointed Assistant in Charge of Statistics and Methods of the Fisheries, a major division of the Fish Commission, in 1893. In that capacity he served until 1897. His ability was recognized at once as in 1895 he was named "Acting Commissioner of Fisheries" during the absence of the Commissioner as indicated in the Washington Post for August 6, 1895:

> Col. Marshall McDonald, United States Fish Commissioner, is in the Adirondacks. Dr. Hugh M. Smith is the Acting Commissioner during the absence of his chief.

He became, in 1897, Assistant in Charge of Scientific Inquiry, the investigational division of the Fish Commission. During 1901 and 1902 he served as director of the Fisheries Biological Station at Woods Hole, Massachusetts. Then, in 1903, came his appointment to a position newly created by Congress, bearing the title United States Deputy Commissioner of Fisheries. In this position he stood next to the Commissioner in authority and responsibility. Dr. Smith served in that capacity until 1913 when President Wilson appointed him to the office of United States Commissioner of Fisheries. At that time, Dr. David Starr Jordan wrote the following letter:

> Secretary Redfield writes me that he has decided on your appointment as Commissioner of Fisheries. Permit me to congratulate you on this selection, as well as to congratulate the Bureau and the fishery interests generally. It is a great pleasure to me to see a man of both scientific and business fitness chosen for a position of the importance of this one.
>
> Very truly yours,
> (Signed) David Starr Jordan
> (March 29, 1913)

Dr. Smith's immediate predecessor in office, who was not a trained naturalist, relied extensively upon his Deputy Commissioner for advice as to the investigational work of the Bureau. It may be said, therefore, that Dr. Smith planned and directed the investigations of the fisheries, in a large measure, long before he became Commissioner. It may be stated, also, that no other Commissioner came to that office with a wider and more thorough knowledge of the fisheries, and of the accomplishments of the Bureau of Fisheries and the problems it still had to meet.

Upon relinquishing office as Commissioner of Fisheries in 1922, the Secretary of the Department of Commerce wrote the following letter, dated December 23, 1921:

I am in receipt of your letter of December 15th enclosing your resignation as Commissioner of Fisheries, which I beg to accept.

I believe your service for thirty-six years, rising from the bottom to the top, in one of our great scientific bureaus is unique in the history of the Government. The whole country is under an obligation to you for so long and faithful a service.

Yours faithfully,
(Signed) Herbert Hoover

Dr. Hugh M. Smith and his office staff of the United States Bureau of Fisheries in front of the Old Armory Building at Sixth and Independence Ave., Washington, D.C. 1914.

A local paper at that time paid Dr. Smith the following tribute:

His administration has been noteworthy as to scientific and economic accomplishments of the bureau, but especially noteworthy in that it kept the bureau entirely free from politics. Although that branch of the government could easily become a potent political organization, as was evidenced by some of his predecessors, no criticism of political bias or activity has ever been made of his administration.

Those familiar with the fisheries problems of this country have united in giving Dr. Smith the credit for the way he has built up an efficient organization, both as to office personnel and field service. The responsible staff at the heaquarters of the bureau here in Washington comprises the best experts in the country, all selected by the commissioner from the ranks, after a demonstration of their fitness in subordinate capacities. Harmonious cooperation with the fisheries bureaus of the several states has been a consistent feature of his administration, and it is certain that that part of the general public which has knowledge of the widespread improvements brought about under his supervision, including many thousands of anglers, will regret his departure.

The Service Bulletin (No. 85, 1922) of the Bureau of Fisheries, a publication established by Dr. Smith, carried an article pertaining to his retirement, which stated in part:

> The retiring Commissioner has always shown toward his colleagues in the Bureau a friendly consideration which has won for him their affectionate esteem, and wherever he may be and in whatever he may undertake he will have their best wishes and their confidence in his continued usefulness to his country and his fellowmen.

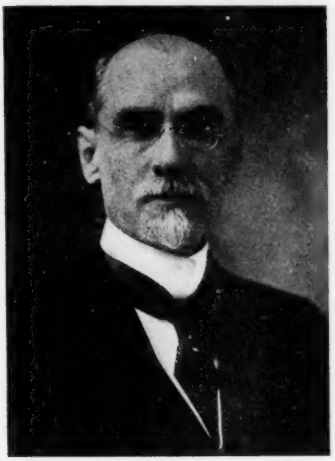
The extensive administrative duties that the several executive positions held by Dr. Smith of necessity required of him might have kept a less active man from continuing investigations in the field and from contributing scientific papers. Though administrative duties did greatly reduce the time available for investigational work, Dr. Smith somehow found time to travel extensively, often carrying his investigations of the fisheries to remote and almost inaccessible places, not only in the United States, but also into foreign lands. Few persons, perhaps, have traveled more extensively in the United States, or have a more intimate knowledge of its shore lines, lakes and streams. His foreign travels in the interest of the Bureau of Fisheries also are wide. Nearly all of his travels were first hand investigations, necessitating long journeys and considerable field work.

It is noteworthy that Dr. Smith continued field investigations almost to the very end of his service with the Bureau of Fisheries, as his final field trip took place only a few months before his retirement. At that time he undertook a strenuous trip through virtually unexplored parts of the Yellowstone National Park. An assistant in the field service of the Bureau of Fisheries, after completing a particularly long, arduous wilderness expedition that the two had made together said, "Dr. Smith, to my mind, is the best combination of an eminent scientist, good woodsman, and good all-round fellow I've ever met."

From 1907 to 1910, in addition to his work as Deputy Commissioner, Dr. Smith served as director of the Bureau of Fisheries expedition for the investigation and development of the fisheries and aquatic resources of the Philippine Islands. The United States Fisheries steamer, "Albatross," served as the base from which the investigations were conducted. One of the largest collections of fish and other aquatic animals ever assembled was obtained on this expedition, and many papers based on this collection (even now not fully reported), written by Dr. Smith and others, form the chief source of our knowledge of the aquatic life of that region.

Dr. Smith already had published several papers on birds, in which he has always retained an interest, when he entered the service of the Fish Commission. Very early he showed considerable ability as a writer. His first paper in the Fish Commission series appeared only a few years after his employment. He soon became a prolific writer on fisheries matters, and papers came from his pen in a more or less continuous flow. They cover a wide range of subjects, dealing with many forms of animal life, but principally with the aquatic ones that enter commerce. They are all characterized by their excellent literary style, by the clear and readily understandable presentation of facts, and they show a comprehensive grasp of the matter treated. Some of his

books and papers are strictly technical, some bear principally on the economic phases of the fisheries, and still others are popular in style. As Dr. Smith never sacrificed or modified facts to make his articles interesting, his popular works, which appeared mostly in periodicals, are of much general educational value.



Dr. Hugh M. Smith as Commissioner of Fisheries, 1914

The earliest publication with which Dr. Smith's name is associated as author in the United States Fish Commission series appeared in the Bulletin, (7, October 9, 1888: 161–192). This paper was entitled "The American Sardine Industry in 1886," and although R. Edward Earll and Hugh M. Smith are given as authors, it is evident from the introduction that the junior author wrote it and that Mr. Earll did the field work. Other publications by Dr. Smith alone or in cooperation with his coworkers soon followed, and kept coming from time to time, generally several each year throughout his long service. The last one published during his service with the Bureau of Fisheries, written with the late Dr. William C. Kendall as junior author, entitled, "Fishes of Yellowstone National Park" (Rept. of the U. S. Commissioner of Fisheries for 1921, Appendix 3: 30 pages, 16 figures) was issued December 31, 1921, that is a little more than 33 years after his first paper in the bureau's series appeared, and in his final report as Commissioner of Fisheries.

Many honors, some of them involving great responsibility, were bestowed upon Dr. Smith during his long and distinguished service with the Bureau of Fisheries. In 1900 he was appointed representative of the United States at the first international fishery congress at Paris; in 1905 he again represented this country at the third international fishery congress in Vienna; and in 1908 he was the United States representative at the fourth international fishery congress held in Washington, of which he was secretary general. In 1910 Dr. Smith served as expert special assistant at the arbitration of the north Atlantic fisheries dispute held at The Hague, and in the same year was named by President Taft as a member of the international commission for the adjudication of disputes arising with Canada and Newfoundland under the award of The Hague tribunal. In 1912 he represented this country on the Permanent Council for the Exploration of the Sea, and a year later he was named by President Taft as joint commissioner on behalf of the United States for the control of the fisheries in the boundary waters of this country and Canada.

Outside of his service with the Bureau of Fisheries, Dr. Smith was hon-

ored by election to the presidency of the American Fisheries Society, the Biological Society of Washington, and the Cosmos Club. Furthermore, in recognition of his outstanding service to the fisheries he was elected to honorary membership in most of the important foreign fisheries societies.

U. S. Fish and Wildlife Service, Washington, D.C.

An Annotated List of Salt and Brackish Water Fishes, with a New Name for a Menhaden, Found in North Carolina since the Publication of "The Fishes of North Carolina" [1] by Hugh M. Smith in 1907

By Samuel F. Hildebrand

FEW catalogues based on the fauna or flora of a restricted area have been used more extensively than Dr. Hugh M. Smith's book, "The Fishes of North Carolina." This work has been the guide for the identification of the local fishes, and the information as to their habitats and life histories included, has been eagerly read, ever since its publication, by the many investigators who have worked at the Fisheries Biological Station at Beaufort. Furthermore, the schools in the state, especially the colleges, use it extensively. At the time of publication Dr. Smith's catalogue was strictly up-to-date, and it has proven to be remarkably free of errors. Much information, however, has been accumulated, especially as to the life histories of the local fishes, and 83 species of salt and brackish water fishes, not known from North Carolina when Dr. Smith's book was written, are listed herewith.

It is not surprising that additional species have been found along the coast, especially in the vicinity of Beaufort, where intensive collecting both in inshore and offshore water has been carried on throughout much of the time since the publication of the catalogue. The additional species secured brings the total number of salt and brackish water species that apparently may be recognized from North Carolina up to about 306. The species of fresh water fish recorded since the publication of the catalogue have not been checked and cannot now be given.

The list that follows includes all the salt and brackish water species, namely 68, that have been recorded from North Carolina, as far as known to the writer, since the publication of Dr. Smith's catalogue. It includes, also, 15 species not previously recorded from North Carolina, and 3 species for which an extension of range within the state is reported.

1 See literature cited.

The name of the author, the year, and page number on which fishes new to North Carolina were reported are given with the list and at the end of the list the publications are cited in full. The exact date and place of capture of each species, if given by the author, or if left in unpublished records that are available to me, are included. It has not been practicable to verify many of the identifications upon which the published records are based, but if there is reason for doubt it is stated. The sequence of the species in the list, for convenience in checking it against Dr. Smith's general catalogue, corresponds to that of the families, and genera if represented, in that work.

List of Species

Ginglymostoma cirratum (Gmelin), nurse shark

Coles, 1915: 89; Radcliffe, 1916: 248.

Recorded from a school observed at Cape Lookout during the summer of 1913, one of which was captured. On Aug. 20, 1930, an individual 166 cm. long, weighing 50 pounds, was caught in Bogue Sound, off Morehead City. Apparently rare locally.

Galeocerdo articus (Faber), tiger shark

Coles, 1915: 89; Radcliffe, 1916: 261.

Recorded from a specimen taken by fishermen at Cape Lookout, June, 1912, and from a school observed inside of Beaufort Inlet, Aug. 8, 1914, 4 of which were caught.

Carcharinus acronotus (Poey)

Gudger, 1913a: 158.

Reported from a specimen taken at Cape Lookout, July, 1911. Reported later by Coles (1915: 90) from 6 others caught at the same place, during July, 1914. A specimen 93 cm. long was taken in an otter trawl in Newport River, Aug. 23, 1930. Apparently locally rather rare.

Carcharinus limbatus (Müller and Henle)

Gudger, 1913b: 158; Coles, 1915: 90; Radcliffe, 1916: 255.

First reported from a specimen caught at Cape Lookout by Russell J. Coles, in July, 1910. Later taken by others. Apparently not very rare.

Hypoprion brevirostris Poey

Radcliffe, 1913: 396, and 1916: 253.

Fairly common in the vicinity of Beaufort.

Aprionodon isodon (Müller and Henle)

Radcliffe, 1914: 414; 1916: 252.

Record based on a specimen in the Beaufort laboratory collection, 20 inches long, without data.

Alopias vulpinus (Bonnaterre), thresher shark

Radcliffe, 1914: 414; 1916: 246; Coles, 1915: 91.

Records based on a specimen found on the beach at Cape Lookout, April

24, 1913, and on an observation of a live one in the same vicinity, July, 1914, by Russell J. Coles.

Carcharodon carcharias (Linnaeus), man-eater

Coles, 1915: 91; Radcliffe, 1916: 247.

Reported from observations at Cape Lookout. No specimen taken.

Cetorhinus maximus (Gunner)

Coles, 1915: 92; Radcliffe, 1916: 248.

Reported from an individual "about 40 feet long," observed at Cape Lookout, but not captured. Recorded by Brimley (1935: 311) from a specimen taken at Corn Cake Inlet, near Ft. Fisher, Feb. 12, 1935, 13 feet, 5 inches long.

Rhineodon typicus Smith, whale shark

Brimley, 1935: 160.

Reported from an individual estimated as about 40 feet long, that went ashore near the Quarantine Station, Southport Harbor, on June 6, 1934.

Squalus acanthias Linnaeus, spiny dogfish

Gudger, 1912: 143; 1913b: 98; Coles, 1915: 92; Radcliffe, 1916: 267.

Common at Cape Lookout in April and early in May.

Narcine brasiliensis (Ölfers), shockfish

Coles, 1910: 337; Gudger, 1913a: 158; 1913b: 99; Radcliffe, 1916: 207.

First reported by Russell J. Coles from Cape Lookout, later by others. According to Coles it is a regular visitor at Cape Lookout early in June, spending only several days there.

Raja ornata Garman

Radcliffe, 1916: 271.

Reported from three specimens taken by the "Fish Hawk," Sept. 2, 1914, in a beam trawl, about 36 to 40 miles southeast of Cape Lookout Light, one specimen from 66 fathoms and two from 100 to 111 fathoms.

Urobatis sloani (Blainville)

Gudger, 1913a: 160; Coles, 1915: 93; Radcliffe, 1916: 276.

All records appear to be based on a small specimen taken by Russell J. Coles in June, 1911, at Cape Lookout. Listed as *Urolophus jamaicensis* by Gudger and by Coles.

Dasyatis hastatus (De Kay), stingray

Coles, 1910: 338; Gudger, 1913a: 160; Radcliffe, 1916: 273.

First reported from Cape Lookout from a large female with 5 embryos. Rather common in the estuaries about Beaufort.

Dasyatis sabinus (Le Sueur), stingray

Radcliffe, 1913: 396; 1916: 274.

Not uncommon at Beaufort.

Pteroplatea altavela (Linnaeus)

Nichols, 1914: 537; Coles, 1915: 93; Radcliffe, 1916: 277.

Records all based on a large female, with 4 well developed embryos, taken at Cape Lookout, May 22, 1914.

Mobula hypostoma (Bancroft), small devilfish

Coles, 1910: 341; Gudger, 1913a: 161; 1913b: 102; Radcliffe, 1916: 279.

At times apparently not uncommon at Cape Lookout. Listed as *M. ölfersi* by Coles and by Gudger.

Myrophis punctatus Lütken, worm eel

Hildebrand, 1917: 177.

Numerous under an electric light at the Laboratory pier at Beaufort for several nights during November, 1916. Two captured. Another one taken in an otter trawl in Newport River, Dec. 9, 1930.

Letharchus velifer Goode and Bean, snake eel

Radcliffe, 1914: 414.

Four specimens, taken on the blackfish grounds off Beaufort Inlet, Sept. 7 to 23, 1913, are listed in the records of the "Fish Hawk."

Ophichthus gomesii (Castelnau), snake eel

One specimen, 395 mm. long, taken in Newport River, Beaufort, with an otter trawl. Previously apparently not reported from north of South Carolina.

Ophichthus ocellatus (Le Sueur)

Coles, 1910: 344; Gudger, 1913a: 163.

Both records based on a specimen taken at Cape Lookout in April, 1910, by Russell J. Coles.

Congermuraena balearica (De la Roche)

Radcliffe, 1914: 414; listed without comment.

Two specimens, 155 and 165 mm. long, dredged by the "Fish Hawk" off New River Inlet, in Sept., 1913.

Gymnothorax moringa (Cuvier), spotted moray

Gudger, 1913a: 163.

Recorded from three specimens, one taken at Bird Shoal, Beaufort, Aug. 20, 1903; another at the same place caught in 1904; and still another from near Morehead City, caught in July, 1911. Listed as *Lycodontis moringa* by Gudger.

Sardinella anchovia (Cuvier and Valenciennes)

Reported as *Clupea harengus* by Radcliffe (1914: 414, from several specimens taken in 1913 and 1914), who later changed the identification to *Clupanodon pseudohispanica* (unpublished notes). According to Longley (Carnegie Inst. Washington, 34, Pub. No. 535, 1941) *C. pseudohispanica* is a synonym of *Sardinella anchovia*.

Brevoortia ***smithi,*** new name, yellowfin shad

This species was described by me from specimens from Beaufort (1919: 7), as *B. aureus* (Agassiz). I am now convinced, after examining specimens of *Brevoortia* from Brazil and Uruguay, that the Beaufort fish are specifically distinct from the South American ones. As the species seems to be without a name I propose to name it for Dr. Hugh M. Smith, my former chief, in recognition of his outstanding accomplishments in fishery research, and especially in recognition of his useful book, "The Fishes of North Carolina" (1907).

The description of this species offered in the paper already cited was checked against specimens in hand. It is essentially correct, except that the vertebrae formula should be written 27 + 19 (not 7 + 39). *B. smithi* differs prominently from the local common menhaden, as well as from the South American material examined, in having much smaller scales, which are arranged in notably less regular rows.

B. smithi is not uncommon in the estuaries in the vicinity of Beaufort. A specimen 295 mm. long (235 mm. to base of caudal), U.S.N.M. No. 118723 is designated as type, and 2 specimens, U.S.N.M. 84368 as paratypes.

Jenkinsia lamprotaenia (Gosse)

Two specimens, 42 and 47 mm. long, taken with an otter trawl, Mar. 17, 1930, near Beaufort Inlet. As the specimens are soft and somewhat damaged the specific identification is uncertain. Apparently not previously reported from north of southern Florida.

Anchovia argyrophana (Cuvier and Valenciennes)

Radcliffe, 1914: 414; recorded without comment.

Record evidently based on one or more specimens listed from the Mullet Pond on Shackleford Banks, July 18, 1913, in Dr. Radcliffe's unpublished notes. This fish and the next one probably are both referable to *A. eurystole.*

Anchovia perfasciata (Poey)

Radcliffe, 1914: 414; recorded without comment.

Record apparently based on one or more specimens, listed from Pivers Island, Beaufort, June 30, 1913, in Dr. Radcliffe's unpublished notes. Probably referable to *A. eurystole.*

Synodus intermedius (Agassiz), lizardfish

Hildebrand, 1917: 177.

First reported from a specimen, 295 mm. long, taken by commercial fishermen, on the blackfish grounds off Beaufort Inlet, Nov. 16, 1916. Another specimen, 77 mm. long, taken by the "Fish Hawk" in the Gulf Stream off Beaufort, Sept. 1, 1914, was found later in the collections.

Trachinocephalus myops (Forster)

A specimen 293 mm. long was taken by the "Grampus," 12 miles south and east of Frying Pan Shoals Lightship, in 12 fathoms, Dec. 6, 1916. Another specimen was reported to me by letter by Dr. H. F. Prytherch, May

27, 1941, taken in the vicinity of Beaufort. Although this tropical species has been recorded from as far north as Woods Hole, Massachusetts, it was not heretofore reported from North Carolina.

Alepisaurus ferox Lowe, lancetfish

Brimley, 1938: 245.

Reported from a specimen 132.5 cm. long, taken in the surf near Oregon Inlet, Apr. 7, 1938, by S. A. Walker, superintendent, Pea Island Game Refuge, who saw another specimen near the same place, May 11, 1937.

Fundulus luciae (Baird)

Hildebrand, 1916: 306.

Common to numerous in the Mullet Pond on Shackleford Banks, and in marshes on Newport River. Generally associated with *Fundulus heteroclitus*.

Fundulus ocellaris Jordan and Gilbert

Hildebrand, 1916: 306.

Common in the Mullet Pond on Shackleford Banks: also taken in a pond at Ft. Macon, and in a marsh on North River. Generally associated with *Fundulus heteroclitus*.

Cypselurus furcatus (Mitchill), four-winged flyingfish

Hildebrand and Cable, 1930: 449.

Reported from 50 specimens, including adults and young, all taken off Beaufort Inlet, from 6 to about 30 miles off shore.

Parexocoetus mesogaster (Bloch), short-winged flyingfish

Smith, 1907: 165; no definite record from North Carolina; Radcliffe, 1914: 414; listed without comment; Hildebrand and Cable, 1930: 445.

Many specimens, including adults and young, were taken by the "Fish Hawk," during the summers of 1913 to 1915, while operating from Beaufort in off shore waters.

Menidia beryllina (Cope), silverside

Hildebrand, 1916: 306, and 1923: 118.

Rather common in brackish and fresh water in vicinity of Beaufort.

Sphyraena barracuda (Wallbaum), great barracuda

Hildebrand, 1916: 306.

Three specimens, 120, 215, and 250 mm. long, were taken at Pivers Island, Beaufort, Nov. 3, 1914; another at Cape Lookout, Aug. 7, 1915. Reported as scarce at Beaufort, but common off Southport by Dr. H. F. Prytherch (*in litt.*, May 27, 1941).

Sphyraena guachancho Cuvier and Valenciennes, barracuda

Recorded here for the first time from North Carolina from two specimens, 450 and 512 mm. long, seined in an estuary near Beaufort, May 27, 1931.

Polynemus octonemus Girard, threadfin

Coles, 1910: 345; Gudger, 1913a: 345.

Both records are based on a specimen caught at Cape Lookout, April, 1910, by Russell J. Coles. A 255-mm. specimen was taken in North River by fishermen, Sept. 9, 1925, and still another one, 250 mm. long, was reported from Beaufort by Dr. H. F. Prytherch (*in litt.*, May 27, 1941).

Polynemus virginicus Linnaeus, threadfin

A specimen 310 mm. long was caught at Cape Lookout, May 8, 1917. Apparently previously not recorded from north of Florida.

Acanthocybium solanderi (Cuvier and Valenciennes), wahoo

A photograph of a wahoo appeared in the *Washington Post* (D.C.), Aug. 30, 1940, the caption stating that the fish had been caught in the Gulf Stream, off Cape Hatteras. A specimen caught at Hatteras (presumably the same fish), weighing 20 pounds, was delivered to Dr. H. F. Prytherch, Fisheries Biological Station, Beaufort, who reported by letter another one of about the same size taken off Cape Lookout in the autumn of 1940.

Pneumatophorus colias (Gmelin), chub mackerel

A 12-inch specimen, taken in the vicinity of Beaufort, was reported to me (*in litt.*) by Dr. H. F. Prytherch. Previously known only as far south as Chesapeake Bay.

Germo alalunga (Gmelin), long-finned albacore

A specimen weighing 37½ pounds, taken in a net at Ocracoke, was brought to the Fisheries Biological Station, Beaufort, in about 1938. Identification and notice of catch submitted by letter by Dr. H. F. Prytherch.

Hemicaranx amblyrhynchus (Cuvier and Valenciennes)

Radcliffe, 1914: 414; reported without comment.

Not rare in and outside of Beaufort Inlet to Cape Lookout. The North Carolina specimens differ from examples from Panama (Atlantic), and probably are not *H. amblyrhynchus*.

Decapterus punctatus (Agassiz), round scad

Gudger, 1913b: 105; Hildebrand and Cable, 1930: 453.

Reported by Gudger from an 200-mm. specimen taken at Cape Lookout by Russell J. Coles. As the young were found to be quite numerous in towings made off Beaufort Inlet from 1927 to 1931 the adults probably are not rare, but usually escape collecting nets.

Naucrates ductor (Linnaeus), pilotfish

A specimen 365 mm. long was secured in a Beaufort fish house, Nov. 17, 1928, having been caught by local fishermen. Previously not recorded from North Carolina.

Apogonichthys alutus (Jordan and Gilbert), cardinal fish

New record, based on a ripe female, 45 mm. long, taken on the blackfish grounds off Beaufort Inlet, by the "Fish Hawk," Aug. 12, 1914.

Morone americana (Gmelin), white perch

Several examples were taken in fresh water of Newport River by Dr. James S. Gutsell, Jan. 11, 1932. Previously recorded from various waters of the state, but not from the vicinity of Beaufort.

Rypticus bistrispinus (Mitchill), soapfish

Radcliffe, 1914: 414; recorded without comment.

According to "Fish Hawk" records one specimen was taken with hook and line on the blackfish grounds off Beaufort Inlet, Sept. 7, 1913, and another one with a beam trawl in the bay at Cape Fear, Sept. 24, 1913. *R. bistrispinus* is listed by Schultz and Reid (Proc. U.S. Nat. Mus., 87, No. 3074, 1939: 265) as a synonym of *R. saponaceus saponaceus.*

Lutianus synagris (Linnaeus), lane snapper

A juvenile, 19 mm. long, was seined at Pivers Island, Beaufort, Aug. 10, 1927. It seems to agree with small specimens from Panama (Atlantic). Apparently not recorded from north of Florida.

Rhomboplites aurorubens (Cuvier and Valenciennes)

Radcliffe, 1914: 414; recorded without comment.

According to the records of the "Fish Hawk" one specimen was taken on the blackfish grounds, off Beaufort Inlet, Sept. 6, 1913.

Stenotomus aculeatus (Cuvier and Valenciennes), southern scup

Although Smith (1907: 297) included this species, he was unable to give a definite North Carolina record. Radcliffe (1914: 5) reported it from the blackfish grounds off the mouth of New River Inlet (2 specimens, according to the "Fish Hawk's" records, were taken). Another specimen, 62 mm. long, was trapped in a pound net in Newport River, May 21, 1914.

Calamus calamus (Cuvier and Valenciennes), porgy

Radcliffe, 1914: 414; recorded without comment.

A specimen was taken on the blackfish grounds off Beaufort by the "Fish Hawk," June 27, 1913; another about 315 mm. long, also from the blackfish grounds, was brought to a Beaufort fish house, Oct. 18, 1930, by commercial fishermen.

Pagrus pagrus (Linnaeus)

Radcliffe, 1914: 414; recorded without comment.

Three specimens are listed in the records of the "Fish Hawk." Two from the blackfish grounds, off Beaufort Inlet, taken with hook and line, Sept. 22, 1913, and one from near Lookout Shoals, taken by the same method in about 13 fathoms, Oct. 17, 1913. A 325-mm. specimen was reported by Dr. H. F. Prytherch (*in litt.*) May 27, 1941.

Ulaema lefroyi (Goode)

McGlone, 1908: 572.

Reported from "a number of small ones" secured at a Pivers Island jetty, Beaufort, Aug. 3, 1907. Apparently very rare locally.

Eques lanceolatus (Linnaeus), ribbon fish

Reported in the *Beaufort News*, Feb. 9, 1939, from a specimen taken in a trawl off Cape Lookout. Identification confirmed by letter by Dr. H. F. Prytherch, director of the Fisheries Biological Station, Beaufort.

Abudefduf saxatalis (Linnaeus), sergeant major

McGlone, 1908: 572.

Seined at Ft. Macon Jetty, Aug. 10, 1907. Apparently taken only one other time in North Carolina, namely, July 25, 1916, when several small specimens were seined in approximately the same place.

Zenopsis ocellatus (Storer)

Firth, 1931: 162.

This northern fish was reported from a specimen 197 mm. long, taken 75 to 90 miles southeast of Cape Henry, Va., in 28 to 50 fathoms.

Antigonia capros Lowe

Firth, 1931: 162.

One specimen, 91 mm. long to base of caudal, taken 75 to 90 miles southeast of Cape Henry, Va., in 28 to 50 fathoms, Apr. 22 to 24, 1931.

Monacanthus ciliatus (Mitchill), foolfish

Gudger, 1913a: 164.

Record based on a specimen 90 mm. long, taken at Cape Lookout by Russell J. Coles in July, 1911.

Lactophrys tricornis (Linnaeus), cowfish

Gudger, 1913a: 164; 1913b: 107.

Records based on two specimens, each about 100 mm. long, taken at Cape Lookout during July, 1911, by Russell J. Coles.

Lyosphaera globosa Evermann and Kendall

Gudger, 1913a: 165.

Reported from 2 specimens taken at Cape Lookout during July, 1911, by Russell J. Coles.

Masturus lanceolatus (Lienard), pointed-tailed ocean sunfish

Brimley, 1939: 295–303.

Reported from 4 specimens as follows: Browns Inlet, Masonboro Inlet, Pamlico Sound, and Cape Lookout.

Scorpaena colesi Nichols

Nichols, 1914: 537.

Described as new from a specimen 185 mm. long, taken at Cape Lookout, April 23, 1914.

Pontinus rathbuni Goode and Bean

Firth, 1931: 162.

A specimen, 129 mm. in standard length, was recorded from 75 to 90 miles southeast of Cape Henry, Va., in 28 to 50 fathoms.

Cyclopterus lumpus Linnaeus, lumpfish

A 487-mm. specimen, taken at Cape Hatteras in 1941, delivered at the Fisheries Biological Station, Beaufort, has been reported to me (*in litt.*) by Dr. H. F. Prytherch. Previously known from only as far south as Chesapeake Bay.

Bellator egretta (Goode and Bean)

Four specimens, 115, 130, 140 and 170 mm. long, were taken by the "Fish Hawk" in a beam trawl in the Gulf Stream about 30 miles south of Lookout Lightship, July 28, 1915. Previously apparently not recorded north of Tortugas, Florida.

Callionymus calliurus Eigenmann and Eigenmann

Radcliffe, 1914: 414; recorded without comment.

According to the records of the "Fish Hawk," a specimen 14 mm. long was taken on the blackfish grounds off Beaufort Inlet, Sept. 7, 1913. The record evidently was based on this specimen.

Dormitator maculatus (Bloch)

This species was reported from Wilmington by Smith (1907: 364), which apparently is the only record for North Carolina. On Aug. 20, 1925, 2 specimens, 46 and 62 mm. long, were seined in a ditch connected with North River, near Beaufort. This apparently is the northernmost record for the species.

Gobiosoma ginsburgi Hildebrand and Schroeder

Hildebrand and Cable, 1938: 548.

A common species at Beaufort, inhabiting rather deeper water than its common congener, *G. bosci.*

Gobionellus hastatus Girard

Hildebrand and Cable, 1938: 565.

Ten adults, the largest 138 mm. long, taken on very muddy bottom in several different places in brackish branches of Newport River.

Gobionellus oceanicus (Pallas)

Hildebrand and Cable, 1938: 565 and 571.

Reported from 3 adults, the largest 140 mm. long, 2 from Newport River, and 1 from Pivers Island; and from 15 young, partly from Newport River and partly from or near Beaufort Inlet.

Gobionellus shufeldti (Jordan and Eigenmann)

Hildebrand and Cable, 1938: 564.

Four adults, the largest 70 mm. long, taken in fresh water above the "Narrows" in Newport River, in April, 1931.

Evermannichthys spongicola (Radcliffe)

Radcliffe, 1917: 423.

Described from 21 specimens, 20 to 31 mm. long, removed from sponges, taken by the "Fish Hawk," on the blackfish grounds off Beaufort Inlet.

Coryphopterus glaucofraenum Gill

Gudger, 1913a: 165.

Reported from a small specimen taken at Cape Lookout by Russell J. Coles.

Ioglossus calliurus Bean

Radcliffe, 1914: 414; recorded without comment.

A single specimen, taken Sept. 7, 1913, in a mud bag on the blackfish grounds off Beaufort, is listed in the records of the "Fish Hawk."

Porichthys porosissimus (Cuvier and Valenciennes)

Gudger, 1913a: 165.

Reported from a specimen taken at Cape Lookout by Russell J. Coles. My card files include records of at least 8 others taken from 1914 to 1932. Several of these are from Newport River, one from Pamlico Sound, and one off Beaufort Inlet; the largest 200 mm. long.

Blennius stearnsi Jordan and Gilbert

Radcliffe, 1914: 414; recorded without comment.

Record evidently based on a specimen, 33 mm. long, listed in the "Fish Hawk" records, taken about 20 miles off Beaufort Inlet, Sept. 7, 1913.

Gadus callarias Linnaeus, cod

Reported here from a 6-pound individual caught at Cape Lookout, Nov. 24, 1926, and several others from the same place, taken during the winter of 1926–1927; all secured by commercial fishermen. Previously recorded from only as far south as Cape Hatteras.

Urophycis chuss (Walbaum), squirrel hake

Hildebrand and Cable, 1938: 612.

This northern fish was reported from small specimens taken by the "Albatross" off Kitty Hawk.

Urophycis floridanus (Bean and Dresel), Florida hake

Hildebrand, 1916: 306; Hildebrand and Cable, 1938: 612–629.

Although not reported from North Carolina until 1916, the young from about 30 to 150 mm. in length are common to numerous in the estuaries about Beaufort, as well as in and off Beaufort Inlet, from about February to May.

Citharichthys unicornis Goode

This little flounder is recorded here from a male specimen, 56 mm. long, taken Sept. 13, 1914, off Cape Lookout by the "Fish Hawk," at a depth of about 50 fathoms.

Platophrys ocellatus (Agassiz)

Radcliffe, 1914: 414; recorded without comment.

A few specimens, each about 50 mm. long, are listed in the records of the "Fish Hawk," and many young are in the "Fish Hawk" collection made 15 to 20 miles off shore from Beaufort Inlet from 1913 to 1915.

Syacium micrurum Ranzani

Radcliffe, 1914: 414; recorded without comment.

Fourteen specimens were taken by the "Fish Hawk" at several stations off Beaufort Inlet, during the summer of 1913, according to a record found among Dr. Radcliffe's unpublished notes.

Ogcocephalus radiatus (Mitchill), batfish

Radcliffe, 1914: 414; recorded without comment.

Record evidently based on a specimen listed among Dr. Radcliffe's unpublished notes, taken off Bogue Banks, Oct. 31, 1913.

Literature Cited

Brimley, H. H.

1935a Notes on the occurrence of a whale shark (*Rhineodon typus*) in the Cape Fear River, near Southport, N.C. *Jour. E. Mitchell Sci. Soc.*, 51: 160–162, pl. 46.

1935b Basking shark (*Cetorhinus maximus*) in North Carolina waters. *Ibid.*, 51: 311.

1938 The lancet fish (*Alepisaurus ferox*) on the North Carolina coast. *Ibid.*, 54: 245–246.

1939 The ocean sun-fishes of the North Carolina coast. The pointed-tail *Masturus lanceolatus* and the round-tailed *Mola mola*. *Ibid.*, 55: 295–303, pls. 28–30.

Coles, Russell J.

1910 Observations on the habits and distribution of certain fishes taken on the coast of North Carolina. *Bull. Amer. Mus. Nat. Hist.*, 28: 337–348.

1915 Notes on the sharks and rays of Cape Lookout, N.C. *Proc. Biol. Soc. Wash.*, 28: 89–94.

Firth, F. E.

1931 Rare fishes from off North Carolina. Copeia (4): 162.

Gudger, Eugene W.

1912 Natural history notes on some Beaufort, N.C., fishes, 1910–11. No. 1 Elasmobranchii, with special reference to utrogestation. No. 2. Teleostomi. *Proc. Biol. Soc. Wash.*, 25: 141–156; 165–176.

1913a Natural history notes on some Beaufort, N.C., fishes, 1910–11. No. 3. Fishes new or little known on the coast of North Carolina, collected by Mr. Russell J. Coles. *Jour. E. Mitchell Sci. Soc.*, 28: 157–172.

1913b Natural history notes on some Beaufort, N.C. fishes, 1912. *Proc. Biol. Soc. Wash.*, 26: 97–109.

Hildebrand, Samuel F.

1916 The United States Fisheries Biological Station at Beaufort, N.C., during 1914 and 1915. *Science*, (n.s.) 43, Mar. 3: 303–307.

1917 The U.S. biological station at Beaufort, N.C., during 1916. *Science*, (n.s.) 46, Aug. 24: 175–178.

1919 Two species of menhaden occurring on the coast of North Carolina. *Appendix 6, Rept. U.S. Comm. Fish.* for 1918: 8 pages, 2 figs., 1 pl.

1923 Notes on the habits and development of eggs and larvae of the silversides, *Menidia menidia* and *Menidia beryllina*. *Bull. U.S. Bur. Fish.*, 38, 1921–22: 113–120, figs. 85–98.

Hildebrand, Samuel F., and Louella Cable

1930 Development and life history of fourteen teleostean fishes at Beaufort, N.C. *Ibid.*, 47: 383–488, 101 figs.

1938 Further notes on the development and life history of some teleosteans at Beaufort, N.C. *Ibid.*, 48 (24): 505–642, 159 figs.

McGlone, Bartgis

1908 A note on the occurrence of two West Indian fishes at Beaufort, N.C. *Science*, (n.s.)28: 572.

NICHOLS, JOHN T.
1914 A new *Scorpaena* and a rare ray from North Carolina. *Bull. Amer. Mus. Nat. Hist.*, 32: 537–538, 1 fig.
RADCLIFFE, LEWIS
1913 A summary of the work of the U.S. Fisheries marine biological station at Beaufort, N.C., during 1912. *Science*, (n.s.) 38, Sept. 19: 395–400.
1914a The offshore fishing grounds of North Carolina. *Economic Circ. U.S. Bur. Fish.*, 8: 6 pp.
1914b The work of the U.S. marine biological station at Beaufort, N.C., during 1913. *Science*, (n.s.) 40, Sept. 18: 413–417.
1916 The sharks and rays of Beaufort, North Carolina. *Bull. U.S. Bur. Fish.*, 34, 1914: 239–284, 26 figs., pls., 38–49.
1917 Description of a new goby. *Garmannia spongicola*, from North Carolina. *Proc. U. S. Nat. Mus.*, 52: 423–425.
SMITH, HUGH M.
1907 The fishes of North Carolina. *N.C. Geol. and Econ. Surv.*, 2: 445 pages, 188 figs., 21 pls., partly in color.

U.S. FISH AND WILDLIFE SERVICE, WASHINGTON, D. C.

Dorosoma smithi, the First Known Gizzard Shad from the Pacific Drainage of Middle America

By CARL L. HUBBS and ROBERT R. MILLER

AMONG the many new fishes discovered in our survey of the fish fauna of the Pacific drainage in Mexico, perhaps the most outstanding novelty is the new gizzard shad described in this paper. Hitherto no member of the Dorosomidae (or Dorosomatidae), a group now generally included in the Clupeidae, has been known from the Pacific drainage of the New World, although several species of *Signalosa* and *Dorosoma* are recognized (Regan, 1917) from the Atlantic slope of North and Middle America.

It is a sincere pleasure to dedicate this new fish to Hugh McCormick Smith, worthy colleague of such masters as Jordan and Gilbert and Evermann. During the last decade the ranks of America's greatest school of ichthyologists have been almost completely decimated, creating a challenge to carry on.

Dorosoma ***smithi,*** new species

MATERIAL.—The holotype, a fine specimen 121 mm. in standard length, was seined on May 19, 1941, with 4 paratypes, 47 to 124 mm. long, in a flood pool between two branches of Río Piaxtla, near the town of the same name, in the state of Sinaloa, Mexico. The locality is close to 24° N. Lat., hence just outside the Tropics. At the point of collection, about 12 miles from the ocean, and well above tide-water, the water was fresh, vegetation lacking, the bottom mostly of mud with some sand. The pool was 1 to 4 feet deep and about 25 by 80 feet in major dimensions.

Three non-type specimens, 104 to 128 mm. long, are referred to *Dorosoma*

smithi with some hesitation, as they may represent a distinct subspecies. They were seined on March 13, 1940, in Río Muerto, a sluggish coastal distributary of the Río Yaqui, 6 miles south of Vicam and 45.5 road miles south of Guaymas, Sonora. Here the water, 5 feet deep near shore, was muddy, over a bottom of deep mud, and there was no vegetation.

Both series were collected by the junior author's father, Ralph G. Miller, who is energetically collecting specimens for our studies of the fishes of the Pacific drainage.

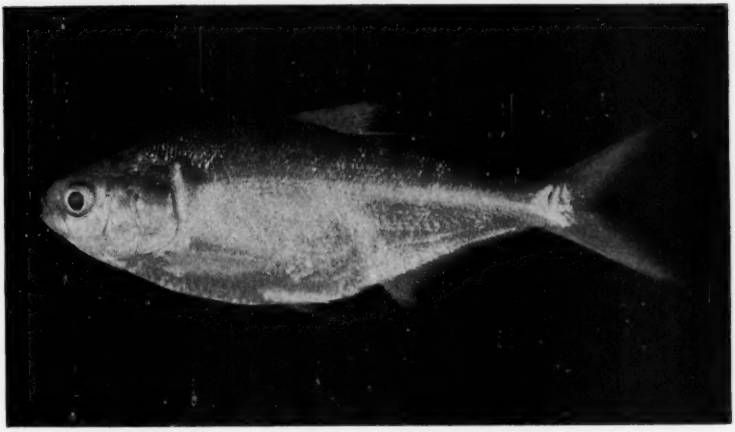


Fig. 1. Holotype of *Dorosoma smithi*

GENERIC REFERENCE.—This new species is referred without question to the genus *Dorosoma*, as it agrees in all essential respects with the type species, *Dorosoma cepedianum*. It corresponds with the description of the Dorosomidae by Jordan and Evermann (1896: 415) and with the diagnosis of *Dorosoma* by Regan (1917: 298 and 311), except in the possession of two supramaxillaries. However, we find that all three hitherto known species of the genus also have an anterior as well as a posterior supramaxillary. The anterior bone is thinner and more scale-like than the posterior one, but is readily seen when a jet of air is thrown on the upper jaw, or by probing, or on dissection. The character of two supramaxillaries separates the American types (*Signalosa* and *Dorosoma*) from all similar Asiatic genera (Regan, 1917, and Herre and Myers, 1931: 234–238), and other differences in mouth and gill structures separate each American genus from any of the Asiatic ones. In these respects, *Dorosoma smithi* is clearly allied to the American rather than the Oriental species.

The inferior mouth, the slender maxillary, the emargination (though slight) of the ventral edge of the upper jaw, and the numerous and rather irregularly arranged scales, all stamp the Pacific species as a member of the genus *Dorosoma* rather than *Signalosa*. The characters of jaw anatomy de-

tailed below, in the specific description, definitely align the new species with *Dorosoma* (and *Clupanodon*) rather than with *Signalosa* (and *Konosirus*). In general the differences in mouth structure which separate *Dorosoma* and *Signalosa* parallel those which, according to Herre and Myers (1931: 234–235), distinguish *Clupanodon* from *Nealosa* (= *Konosirus*)—presumably an example of parallel speciation.

SPECIFIC COMPARISONS.—On comparing *Dorosoma smithi* with *D. cepedianum* and with the types of *D. anale* and *D. chavesi*,[1] we find numerous distinguishing features. The Pacific species differs from *D. cepedianum* (LeSueur), which ranges from New Brunswick to northeastern Mexico, as follows: The scales are more numerous (68 to 75 rather than 54 to 63, according to our counts), and differ in shape and proportions: each scale is rounder, especially on the exposed field, the anterior border of which, instead of being subvertical throughout, forms a definite angle like a cut of pie; the focus is less, not more, than twice as distant from the anterior as from the posterior border of the scale. As in *anale* and *chavesi* the sharp notch in the fleshy flap along the edge of the upper jaw of *cepedianum* is replaced by a much more gentle concavity. At comparable sizes the dorsal filament is shorter (Table 1). The humeral spot of *smithi* appears to be weaker than that of *cepedianum*. It is a slenderer fish, with more compressed head, less swollen muzzle region and smaller eye (Fig. 1). There is a much more definite and broader scaleless strip along the predorsal ridge. The ventral scutes average fewer: 17 or, usually, 18 + 9 to 11, instead of 18 or more commonly 19 + 10 or 11, usually 11. The anal has fewer rays: in both series of *smithi* the range is from 24 to 29 (Table 1); in 99 specimens of *cepedianum* from Mexico, Texas and New Mexico, the counts, with number of specimens in parentheses, are as follows: 26 (3), 27 (2), 28 (1), 29 (7), 30 (10), 31 (26), 32 (21), 33 (18), 34 (11); in each of two phenotypically different series of *cepedianum* from the Arkansas River system in Oklahoma, Hubbs and Whitlock (1929: 463) counted 30 to 36 anal rays.

Compared with the types of *Dorosoma anale* Meek (1904: 93–94, fig. 26; Regan, 1917: 311–312), from southeastern Mexico, *D. smithi* is seen to differ in the much lower number of anal rays, 24 to 29 as against 33 to 38; in the very much shorter dorsal filament (Table 1); in the straight rather than concave contour in the occipital region, and the much less turgid anterior part of the head. The greatest width across the ocular portion of the head is equal to the distance from the tip of the snout to the posterior rim of the pupil rather than the posterior edge of the eye. The anal base is shorter and the anal origin is distinctly behind rather than approximately below the end of the dorsal base. The dorsal fin is more anteriorly inserted (Table 1). The body contours are more symmetrical—deeper posteriorly and less arched along the abdominal ridge—and the body is less sharply compressed, particularly toward the ventral edge (in view of the findings of Hubbs and Whitlock, however, it is possible that these characters are subject to environmental modification). *D. smithi* differs from Guatemala specimens of *anale* much as it does from *cepedianum* in the structure of the scales.

[1] We acknowledge with gratitude the courtesy of Curator Alfred C. Weed of the Field Museum, who allowed us to examine the type specimens of Meek's species.

TABLE 1

COUNTS AND MEASUREMENTS OF THE FOUR SPECIES OF *Dorosoma*

MATERIAL IN FIELD MUSEUM (F.M.) AND UNIVERSITY OF MICHIGAN MUSEUM OF ZOOLOGY (U.M.M.Z.)

TABLE 1

COUNTS AND MEASUREMENTS OF THE FOUR SPECIES OF *Dorosoma*
MATERIAL IN FIELD MUSEUM (F.M.) AND UNIVERSITY OF MICHIGAN MUSEUM OF ZOOLOGY (U.M.M.Z.)

Museum and Cat. No.	Locality	Type designation and species	Dorsal rays	Anal rays	Ventral scutes	Scale rows	Standard length	Thousandths of standard length						
								Predorsal length	Head length	Snout plus eye	Snout length	Eye length	Dorsal filament	Anal base
U.M.M.Z. 133749	Río Piaxtla, Sinaloa	Holotype, *D. smithi*	12	27	18+10	72	121	474	277	121	58	67	173	270
U.M.M.Z. 133750	Río Piaxtla, Sinaloa	Paratype, *D. smithi*	11	29	18+9	72	125	490	289	128	62	69	224	295
U.M.M.Z. 133750	Río Piaxtla, Sinaloa	Paratype, *D. smithi*	11	26	17+9	74	124	506	293	127	61	70	216	284
U.M.M.Z. 133750	Río Piaxtla, Sinaloa	Paratype, *D. smithi*	11	26	18+9	69	117	494	295	129	52	72	184	272
U.M.M.Z. 133750	Río Piaxtla, Sinaloa	Paratype, *D. smithi*	11	27	18+9	68?	47	487	306	143	56	85	94	309
U.M.M.Z. 133751	Río Muerto, Sonora	Variants, *D. smithi*	12	24	18+11	70	128	477	275	116	55	63	171	264
U.M.M.Z. 133751	Río Muerto, Sonora	Variants, *D. smithi*	11	25	18+9	71?	124	540[1]	283	116	55	61	159	291
U.M.M.Z. 133751	Río Muerto, Sonora	Variants, *D. smithi*	11	24	18+11	75	104	481	278	116	56	63	144	268
U.M.M.Z. 120190	Brazos R. system, Texas	*D. cepedianum*	12	34	19+11	58	140	491	283	125	53	71	261	271
U.M.M.Z. 129838	Brazos R. system, Texas	*D. cepedianum*	11	32	18+11	63	123	498	278	127	62	80	239	270
U.M.M.Z. 129850	Brazos R. system, Texas	*D. cepedianum*	12	33	19+10	60	126	501	303	129	61	77	258	298
U.M M.Z. 129850	Brazos R. system, Texas	*D. cepedianum*	12	31	19+10	63	115	504	306	135	63	79	258	289
U.M.M.Z. 110538	Brazos R. system, Texas	*D. cepedianum*	12	31	19+11	59	119	491	283	135	58	83	285	292
U.M.M.Z. 110538	Brazos R. system, Texas	*D. cepedianum*	12	31	19+11	58	119	496	278	131	60	81	240	286
U.M.M.Z. 110463	Near Albuquerque, N. M.	*D. cepedianum*	12	32	19+11	54	47	550	352	167	74	102	168	256
U.M.M.Z. 130361	Río Salado, Coahuila	*D. cepedianum*	11	27	18+10	58	135	490	275	122	64	71	244	272
U.M.M.Z. 130332	Río Sabinas, Coahuila	*D. cepedianum*	11	31	19+11	57	104	493	284	129	56	74	211	281
U.M.M.Z. 130425	Río San Juan, Coahuila	*D. cepedianum*	12	29	19+10	61	149	504	288	125	67	74	261	249
F.M.	Sta. Engracia, Tamaulipas	*D. cepedianum*	13	33	19+11	61	245	498	260	101	51	52	258	285
F.M. 4637	El Hule, Oaxaca	Holotype, *D. anale*	10	35	19+9	70	146	533	288	119	54	71	309	342
F.M. 4190	El Hule, Oaxaca	Paratype, *D. anale*	12	37	19+9	70	134	523	288	124	58	73	316	353
F.M. 4191	El Hule, Oaxaca	Paratype, *D. anale*	11	33	19+9	72	131	524	295	122	55	76	313	325
F.M. 5928	Laguna Jenicero, Nicaragua	Paratype, *D. chavesi*	13	29	18+9	79	142	540	313	142	70	77	156	299
F.M. 5928	Laguna Jenicero, Nicaragua	Paratype, *D. chavesi*	13	30	17+10	75	142	546	314	139	73	71	137	289
F.M. 5928	Laguna Jenicero, Nicaragua	Paratype, *D. chavesi*	12	28	18+10	69	138	540	309	138	70	76	154	297
F.M. 5928	Laguna Jenicero, Nicaragua	Paratype, *D. chavesi*	15	29	19+9	72	137	546	319	150	69	82	141	303
F.M. 5928	Laguna Jenicero, Nicaragua	Paratype, *D. chavesi*	13	25	18+9	76	136	549	322	148	71	79	168	295
F.M. 5928	Laguna Jenicero, Nicaragua	Paratype, *D. chavesi*	13	28	18+9	68	135	552	315	146	72	76	141	296
F.M. 5928	Laguna Jenicero, Nicaragua	Paratype, *D. chavesi*	13	27	18+9	70	123	546	323	155	76	81	171	288
F.M. 5926	Lago Managua, Nicaragua	Paratype, *D. chavesi*	14	29	18+9	76	152	552	342	153	75	82	198	255
F.M. 5926	Lago Managua, Nicaragua	Paratype, *D. chavesi*	12	26	17+10	71	124	538	341	159	77	86	167	229
F.M. 5926	Lago Managua, Nicaragua	Paratype, *D. chavesi*	14	28	18+10	72	121	540	327	144	75	83	167	292
F.M. 5926	Lago Managua, Nicaragua	Paratype, *D. chavesi*	13	28	19+10	71	101	527	335	156	73	87	174	244

[1] This value is abnormally high, on account of an obvious injury in the predorsal region.

Dorosoma smithi is obviously different too from the Nicaraguan species, *D. chavesi* Meek (1907: 112; Regan, 1917: 312), which it resembles in the short dorsal filament. It differs greatly from the types of that species, and agrees with the other species of the genus, in the small size of the mouth: the mandible is less than one-third instead of nearly one-half as long as the head, and the upper jaw is about one-fourth rather than about one-third as long as the head. The eye and snout are shorter than in *chavesi* (Table 1). *D. smithi* differs from *chavesi* as it does from *anale* in the more regular anterodorsal contour. The dorsal rays number 11 (usually) or 12, instead of 12 to 15, and the dorsal fin is distinctly more anterior in its insertion (Table 1).

DESCRIPTION.—The characters of *D. smithi* are largely indicated in the preceding comparisons, in the counts and measurements (Tables 1 and 2) and in Figure 1. Certain structures of the head region, however, call for a more thorough description.

As seen from the front, the closed mouth is rather V-shaped; the apex is only a little below the horizontal that passes through the middle of the pupil. The open mouth is rather shield-shaped. When the mouth is tightly closed, the small symphyseal knob fits into a notch distinctly behind the front of the premaxillaries so as to leave a soft, fleshy interspace about one-fourth as wide as the pupil. Toward the symphyseal knob the mandible is thin and transversely flattened, but the rather sharp, bony outer edge fits well up inside the upper jaw. Inside the mouth each mandibular ramus is rather abruptly elevated. At the sides anteriorly the mandible is little expanded, as seen from below. The upper jaw extends backward about to below the front of the pupil. The fleshy lower edge of the upper jaw is convex anteriorly, in side view, and forms a rather sharp keel behind its middle. Here the fleshy edge is extended as a rounded flap in front of which there is a small concavity, and in back of which there is a somewhat deeper emargination representing the sharp notch of *D. cepedianum*. The edge of the flat premaxillary is subvertical and is curved into an almost anterior position medially. The overlap of the premaxillary on the maxillary is about two-thirds the length of the pupil and about one-third the length of the maxillary. In this area of overlap, however, the premaxillary is not adnate to and does not fit into the edge of the maxillary, but instead lies free in the rather thick upper lip, which is separated by a long groove from the straightish, rod-like anterior part of the maxillary. Posteriorly the maxillary is extended ventrally, below the thickened portion, as a thin wing, but is not abruptly bent downward. The maxillary extends beyond the premaxillary a distance approximately equal to the premaxillary length. The thin posterior supramaxillary covers the upper, posterior part of the maxillary and gives off an anterior spine-like process about as long as the main part of the bone. Over the upper edge of the maxillary just below this process there lies a very thin and rather slender anterior supramaxillary (as noted above, generally overlooked by authors), about half as long as the pupil.

As in other species of the genus, the gill-rakers are exceedingly numerous. Those of the upper and lower limbs do not overlap, but meet at rather sharp

angles. As in related forms, the rakers, at frequent intervals, bear wide, fleshy wings near their bases. The longest (submedian) gill-rakers of the lower limb are hardly two-thirds as long as the opposite gill-filaments. At the junction of the two bones the dilated end of the ceratobranchial is about twice as wide as the end of the basibranchial; hence there is an abrupt break in the location of the bases of the filaments. The filaments of the two demibranchs are subequal in length.

The free section of the suborbital is rather rhomboidal, and narrower than the pupil medially. The free portion of the interopercle is J-shaped as seen from the right side.

TABLE 2

ADDITIONAL COUNTS AND MEASUREMENTS OF *Dorosoma smithi*

Character	Holotype	Paratypes				Variants		
Scales, dorsal origin to anal origin	37	34	35	33	36?	34	33	35
Pectoral rays	14	14	14	14	15	13	14	15
Pelvic rays	8	8	8	8	8	8	8	8
Caudal rays (principal)	19	19	19	19	19	19	...	19
Standard length, mm	121	125	124	117	47	128	124	104
Measurements in thousandths of the standard length								
Depth of body								
Greatest	351	363	386	360	361	347	362[1]	339
Over anal origin	266	275	292	270	286	273	304[1]	272
Caudal peduncle	101	104	109	107	111	106	79[1]	112
Anal origin to caudal base	373	386	374	369	405	376	383	386
Head								
Depth	218	221	224	220	235	210	217	205
Width	122	122	126	127	120	115	112	102
Interorbital, least fleshy width	80	74	77	81	84	66	71	63
Upper jaw, length	76	77	77	78	83	73	77	75
Mandible, length	95	93	93	96	109	90	92	93
Dorsal fin								
Height	209	215	221	230	237	224	246	227
Basal length	132	135	136	138	141	128	127	123
Lower caudal lobe	319	326	341	331	324	319	...	320
Pectoral length	207	210	218	227	204	199	211	197
Pelvic length	125	120	124	122	138	122	132	128

[1] Measurement unreliable, owing to injury of specimen.

The eye is covered by a hyaline adipose eyelid leaving a free space about as wide as the pupil medially. The upper end of the opening is a rounded angle. At the lower end there is a sharp notch where the anterior rim overlaps the posterior one.

VARIANT SERIES.—The 3 specimens from Río Muerto in Sonora are almost surely to be referred specifically to *Dorosoma smithi*, but, as noted above, they may represent a distinct subspecies. Characters of the variants are included in Tables 1 and 2, and the differential features are pointed out in the following comparison.

The specimens from Sonora seem to differ from the Sinaloan types in at least 8 respects: the anal rays probably average fewer; the ventral scutes more numerous; the body is slenderer; the head is perhaps shorter, and narrower and less deep; the snout and the eye are smaller and the interorbital narrower; the greatest width across the head in the eye region measures 2.8

to 3.0, rather than 2.5 to 2.8 times, in the length of the head; the depth of the snout at the vertical passing midway between nostril and eye enters the head length 3.8 to 3.9, instead of 3.3 to 3.5 times; the dorsal base is shorter. Probably some of these apparent differences will disappear when larger series are available, and the differences which now show no overlap will probably be found to grade together.

Literature Cited

Herre, Albert W., and George S. Myers
1931 Fishes from southeastern China and Hainan. *Lingnan Sci. Jour.*, 10: 233–254.
Hubbs, Carl L., and Stanley C. Whitlock
1929 Diverse types of young in a single species of fish, the gizzard shad. *Pap. Mich. Acad. Sci., Arts and Letters*, 10: 461–482, figs. 31–40.
Jordan, David Starr and Barton Warren Evermann
1896–1900 The fishes of North and Middle America. *Bull. U.S. Nat. Mus.*, 47 (4 parts): 1–3313, pls. 1–392, 2 figs.
Meek, Seth Eugene
1904 The fresh-water fishes of Mexico north of the Isthmus of Tehuantepec. *Publ. Field Col. Mus.*, = 93 (Zool.) 5: i–lxiii, 1–252, figs. 1–72, pls. 1–17, 1 map.
1907 Synopsis of the fishes of the Great Lakes of Nicaragua. *Ibidem*, 121 = (Zool.) 7: 97–132, 2 figs.
Regan, C. Tate
1917 A revision of the clupeoid fishes of the genera *Pomolobus*, *Brevoortia* and *Dorosoma*, and their allies. *Ann. and Mag. Nat. Hist.*, (8) 19: 297–316.

Museum of Zoology, University of Michigan, Ann Arbor, Michigan.

A New Species of Lizard from Siam

By Doris M. Cochran

An apparently undescribed skincid lizard from Khun Tan, N. Siam., while allied to a species described from Burma, seems to merit specific distinction, and may be called:

Leiolopisma ***smithi,*** new species

Diagnosis.—Dorsal scales distinctly larger than laterals, in 6 rows across the back, the gradation into the lateral scales not very abrupt; 3 rather irregular pairs of nuchals; snout moderately short, obtusely rounded; no light vertebral stripe; 28 scales around the body; ear without projecting lobules; ear-opening much larger than palpebral disk; belly not white. Allied to *Leiolopisma doriae* (Boulenger), differing in the ventral coloration, in the shorter frontal, and in the wide contact between the prefrontals.

Type.—U.S.N.M. No. 94536, an adult from Khun Tan, N. Siam, collected March 2, 1932, by Dr. Hugh M. Smith.

DESCRIPTION OF THE TYPE.—Distance between end of snout and forelimb contained 1½ times in distance from axilla to groin; no supranasals; frontonasals much broader than long, widely separated from the frontal by the frontonasals; prefrontals widely in contact; frontoparietals and interparietal distinct, about equal in area; frontal 3/5 as long as frontoparietals and interparietal together; parietals forming a short suture behind interparietal; 3 rather irregular pairs of nuchals; 7 superciliaries; 4 large supraoculars; 7 upper labials, 5th and 6th below eye; ear-opening much larger than the transparent palpebral disk; no projecting lobules. Body-scales smooth, dorsals twice as long and twice as wide as the laterals; 28 scales around the body, 6 across the back (between the dark lateral stripes); a pair of large median preanals, with a smaller scale at the side of each; tail (reproduced) only a little longer than head and body, with a median series of transversely enlarged scales below it; the adpressed limbs barely fail to meet. Digits long; 18 smooth or very bluntly keeled lamellae under the 4th toe.

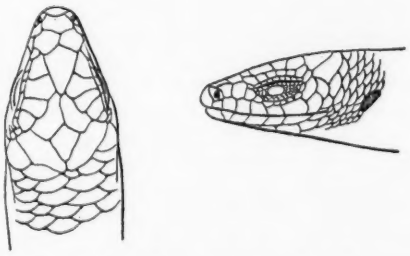


Fig. 1. Dorsal and lateral scutellation of the head of the type of *Leiolopisma smithi*, new species, x 6.

Color in alcohol.—Dorsum metallic sepia; a dark clove-brown dorsolateral line beginning at the nostril and continuing behind the eye, above the ear and down the sides onto the tail, becoming much interrupted behind the axilla, so that it appears as a series of irregular dark spots on the posterior body and beginning of tail. Venter immaculate drab-gray. Sides of head, lips and upper surface of arms and legs heavily spotted with clove-brown.

Dimensions (in mm.).—Head and body, 48; head width, 6; head length, 10; tip of snout to fore limb, 18; tail (tip reproduced), 56; axilla to groin, 28; fore limb, 11; hind limb, 16.

It seems possible that the two very young lizards from Doi Suthep, referred provisionally to *Leiolopisma doriae* by Dr. Malcolm Smith (The Fauna of British India. Reptilia and Amphibia, 2, Sauria, 1935: 303) may belong to this new species.

It gives me great pleasure to name this species after Dr. Hugh M. Smith who did so much to increase our knowledge of the Siamese fauna.

U.S. NATIONAL MUSEUM, WASHINGTON, D.C.

Observations on the Migration of Salmonoid Fishes in the Upper Columbia River

By WILBERT MCLEOD CHAPMAN

DURING the period of the preliminary investigations into the possible methods of preserving the Columbia River salmon and steelhead at the Grand Coulee Dam certain miscellaneous observations [1] were made which have a bearing on the "homing" tendency of these fishes.

In 1937 a rack was built across the Wenatchee River near the town of Monitor, about 6 miles above the junction of that river with the Columbia and about 22 miles above Rock Island Dam. Numbers of fish were transported from Rock Island Dam (on the Columbia River) and placed in the Wenatchee River above the rack, for reasons explained elsewhere (State of Washington Department of Fisheries, 1938). Of the steelhead (*Salmo gairdnerii*) so transported, 28 were marked with strap tags at the dorsal edge of the base of the caudal fin before liberation. Those tagged were liberated above the rack between August 21 and September 4. The rack, which had been impassable to the downstream movement of fish, was removed on October 2. All the fish passing the Tumwater Dam, about 22 miles upstream from the Monitor rack, were counted and no tagged steelhead were seen at that point. A careful search was made in the Wenatchee River for about 4 miles below the Tumwater Dam without seeing any of these fish. None of the tagged steelhead were subsequently reported from the Wenatchee River.

In the spring of 1938, five of these tagged steelhead were recovered by sportsmen in the Columbia River: one at Nespelem (about 15 miles downstream from Grand Coulee Dam) and four at Kettle Falls (about 40 miles from the Canadian border). These fish had remained in the Wenatchee River for a month or more. Then some time subsequent to the removal of the Monitor rack they had moved down the Wenatchee to the Columbia (6 miles) and on up the Columbia to Nespelem (about 120 miles) or Kettle Falls (about 230 miles). The simplest interpretation of these results would be that these were fish which had been reared in the upper Columbia drainage and, obeying the "homing" tendency, they had not continued up the Wenatchee (which supports a considerable run of steelhead that normally come into the Wenatchee at this season) but, instead, had returned to the Columbia and turned up the latter toward the streams of their nativity. Since no study has ever been made concerning the home river of the runs of fish appearing at Rock Island the proof of such an interpretation is not possible. If this interpretation is correct, these results present a remarkable instance of the strength of the "homing" tendency.

The observations of Dr. H. B. Ward (1939) on the Baker River and elsewhere have led him to conclude that temperature is an important factor in guiding the migration of the sockeye salmon (*Oncorhynchus nerka*) while in fresh water, and, given similar other conditions, the adult migrants of this species will turn into the tributary having the lower temperature. The Okano-

[1] These observations were made while the writer was employed by the Washington State Department of Fisheries, B. M. Brennan, Director.

gan River is unique among the tributaries of the Columbia River in eastern Washington in having a very high summer temperature. Continuous records of the temperature of the river near the Canadian border were kept during the summer of 1937 (State of Washington Department of Fisheries, 1938). From July 12 to August 20 the lowest temperature of the day recorded was 68° F., it was generally above 70° F., and reached as high as 77° F. Temperatures taken at irregular intervals at the junction of the river with the Columbia were always higher than those recorded at the upper station. The temperature of the Columbia River at Rock Island Dam during this period did not exceed 66° F. and was generally 60° and 64° F. While temperature records are not available for the Columbia at the mouth of the Okanogan it is not conceivable that there would be a temperature drop in the 72 miles between that point and Rock Island. Therefore, during this period (and presumably in the same period in other years) the Okanogan River was from 4° to 12° F. warmer than the Columbia. Yet during this period the normal migration of the sockeye (known as blueback in the Columbia River) took place. At least 2,162 fish (the count at the Oroville Dam on the Okanogan) turned into the Okanogan to reach Lake Osoyoos and about six times that number continued on up the main Columbia toward the Arrow Lakes. Obviously the sockeye in the Columbia do not comply with the temperature theory outlined above.

Dr. Ward also quotes observations made by himself of salmon passing through the ladder at Rock Island Dam (*ibid.*: 96) in which he states:

> The fish kept running up the ladder in good numbers and without the least hesitation until the sun's rays coming over the ridge struck the water in the ladder. Then the salmon run stopped almost immediately and not a single salmon entered the box at the foot of the ladder during the day time. Movements in the afternoon began late, apparently when the rays from the sun in the west were so oblique that the light was totally reflected from the surface of the water and when indirect illumination was also reduced.

TABLE 1

TIME OF PASSAGE OF SALMON AND STEELHEAD GOING OVER ROCK ISLAND DAM FROM MAY 8 TO OCTOBER 27, 1937

	Species											
	Chinook				Blueback				Steelhead			
	Ladder											
TIME[1]	E.	Mid.	W.	Tot.	E.	Mid.	W.	Tot.	E.	Mid.	W.	Tot.
4–8 A.M.	202	510	407	1119	1815	425	2067	4307	155	29	221	405
8–12 Noon	398	865	531	1794	1741	888	1213	3842	344	52	293	689
12–4 P.M.	329	999	307	1635	1376	1063	1190	3629	515	70	220	805
4–8 P.M.	139	599	190	928	957	1339	885	3181	154	31	245	430
8–12 Midnight	4	42	0	46	0	132	0	132	0	0	0	0
Totals	1072	3015	1435	5522	5889	3847	5355	15091	1168	182	979	2329

[1] The time intervals are somewhat misleading. Counting did not start until between 5 and 6 A.M. and ended at dark, which, during the peak of the run, was about 8:30 P.M.

The implication is made that light is a strong influence on the upstream migration of adult salmon. These and other observations are directly in contrast to those made by the present writer in two seasons of intensive study at Rock Island (1937 and 1938). As is shown in the above table, the sockeye

as a whole, showed a preference for running in the early morning, the number decreasing as the day progressed, but those going through the middle ladder acted in a directly opposite manner, running predominantly in the late afternoon. The chinook and steelhead ran heavily through the middle of the day.

While the writer was never able to arrive at a conclusion as to the factors influencing the movements of the fish through the ladder (probably multiple with complex inter-relationships) it is certain that light by itself was not of great importance.

For an explanation of some observations at dams on the Chelan and Similkameen rivers the writer is at a loss. During the summer and fall the entire flow of the Chelan River is passed through a power house from which it emerges into a deep and large pool, thence swiftly over a gravel bottom for about half a mile to its junction with the Columbia. During the summer and fall of 1937 and 1938 observations at this point were made at weekly intervals. Adult sockeye were numerous in the tailrace pool. In 1937 as many as 125 specimens were counted at one time, although the turbulence of the water was such as to make visibility poor. Before spawning time in both years all fish disappeared. None spawned in the river. The Chelan River before the construction of the power diversion had a falls which was impassable for salmon and presumably the lake had not been accessible since glacial times. There is, however, a large population of the land-locked form of this species (kokanee or silver trout) in the lake. Do the adults which come into the Chelan River represent the return from young of the land-locked form in the lake which have migrated to sea or are they merely strays from the run in the main Columbia? Chinook and steelhead were occasionally seen, and those species, as far as is known, have never been in the lake. Old employees at the power house reported that the fish appeared there every year.

At the base of the 60-foot dam on the Similkameen River (about 8 miles upstream from its junction with the Okanogan) similar observations were made. Employees at the power house reported that in other years sockeye had been seen in even larger numbers than in the two years when they were observed by the writer. There has been no possibility of fish getting over this dam for several cycles; but Palmer Lake (about 15 miles farther upstream) has a population of the landlocked form. Young migrants of this species were reported in an irrigation diversion which takes off above the dam but were not identified personally by the writer. As with the Chelan observations there is a choice of two explanations: either the adults are the result of young of the land-locked form which have migrated to the sea and are therefore conforming in their migration with the parent stream theory, or they are strays from the main run in the Okanogan and do not so conform.

Literature Cited

State of Washington, Department of Fisheries
1938 Report of the preliminary investigations into the possible methods of preserving the Columbia River salmon and steelhead at the Grand Coulee Dam. *State of Washington, Department of Fisheries*: 1–121.

Ward, H. B.
1939 The migration and conservation of salmon. *Publ. Am. Ass. Adv. Sci.* 8: 1–106.

United States Fish and Wildlife Service, Anderson Hall, University of Washington, Seattle, Washington.

Fishes of Patricia Portion of the Kenora District, Ontario

By J. R. Dymond and W. B. Scott

THE following records are based on specimens collected or records obtained by parties sent by the Royal Ontario Museum of Zoology during the summers of 1938, 1939 and 1940 respectively, to the following localities in the Patricia portion of Kenora District, Ontario,—Favourable Lake area, Lake Attawapiskat and Fort Severn. The latitudes of these areas are approximately as follows: Favourable Lake 52°, 50′; Attawapiskat 52°, 10′; Fort Severn 56°N.

These expeditions were made possible by a grant from the Reuben Wells Leonard bequest to the Royal Ontario Museum.

The party to the Favourable Lake area consisted of C. E. Hope, L. A. Prince and Morley Neal; those to the other areas of Messrs. Hope, Prince and W. B. Scott. The fish collections were largely the work of Messrs. Neal and Scott but the other members of the parties gave much assistance in the field work.

List of Species

Acipenser fulvescens Rafinesque.—Probably generally distributed; found in Sandy and Deer lakes of the Favourable Lake area, also in Lake Attawapiskat; reported as quite plentiful at Limestone Rapids 25 miles up the Severn River from its mouth.

Amphiodon alosoides Rafinesque.—Quite common in Rat House Bay and shallower portions of Sandy Lake in the Favourable Lake area; not found at Lake Attawapiskat nor Fort Severn.

Cristivomer namaycush (Walbaum).—Found in all the deeper lakes of the area. One hundred pounds of trout were taken from South Trout Lake (Favourable Lake area) each week for four months during the winter of 1937–38; not recorded from Lake Attawapiskat nor Fort Severn but said to occur in Trout Lake, 200 miles inland.

Salvelinus fontinalis (Mitchill).—Not recorded from Lake Attawapiskat nor the Favourable Lake area; common in small, ice-fed streams flowing into the Severn River in the vicinity of Fort Severn. Specimens three pounds in weight and 18½ inches long were taken by the museum party.

Leucichthys tullibee (Richardson).—The lake herrings of Favourable Lake are of the *tullibee* type. Some of those of Lake Attawapiskat are also of this type, while others are of the more slender *artedi* type. It is probable that *tullibee* is an ecological or geographical form of *artedi*.

Leucichthys artedi (Le Sueur).—The lake herrings of the brackish waters about the mouths of the tributary streams of Hudson and James bays have already been reported to be of the *artedi* type.[1]

Leucichthys nigripinnis (Gill).—Found in Lake Attawapiskat but not recorded from other localities visited.

Coregonus clupeaformis (Mitchill).—Fairly common in the deeper lakes including South Trout, Sandy and Deer lakes of the Favourable Lake area and Lake Attawapiskat; not common in the lower reaches of the Severn River.

Catostomus catostomus (Forster).—One of the commonest fishes in the Severn River in the vicinity of Fort Severn; also occurs, but less commonly, in Lake Attawapiskat and in Sandy Lake of the Favourable Lake area.

Catostomus commersonnii (Lacépède).—Common in all lakes in the Favourable Lake area and in Lake Attawapiskat; also occurs in the Severn River but is distinctly less common there than the northern sucker.

---

1 Biological and oceanographic conditions in Hudson Bay. 8. The Coregonine fishes of Hudson and James Bays by J. R. Dymond. Contr. Can. Biol. Fish 8, 1938: 1-12.

Moxostoma aureolum (Le Sueur).—The northern short-headed redhorse is fairly common in Lake Attawapiskat and in the Severn River; not taken in the Favourable Lake area but a redhorse probably of this species reported from Sandy Lake.

Notropis atherinoides Rafinesque.—Common in Lake Attawapiskat.

Notropis heterolepis Eigenmann and Eigenmann.—Fairly common in Lake Attawapiskat, especially in weedy protected bays.

Notropis hudsonius (De Witt Clinton).—Common in Lake Attawapiskat.

Notropis volucellus (Cope).—Several specimens taken in Sandy and North Wind lakes in the Favourable Lake area; also found in Lake Attawapiskat but not in Severn River.

Rhinichthys cataractae (Cuvier and Valenciennes).—Taken in all three localities investigated, in Setting Net Lake in the Favourable Lake area, in Lake Attawapiskat and in Severn River.

Couesius plumbeus (Agassiz).—Very common in the Severn River and reaching a length of 6¼ inches; only one small specimen taken in Lake Attawapiskat and none in the Favourable Lake area but undoubtedly occurs in suitable situations throughout the whole area.

Pfrille neogaea (Cope).—Taken in a small boggy stream draining a large bog in the Fort Severn area; although not taken in the Favourable Lake and Lake Attawapiskat areas, probably occurs in suitable habitats throughout.

Pimephales promelas Rafinesque.—Taken in association with *Pfrille neogaea* in a small boggy stream in the Fort Severn area; not recorded in the Favourable Lake and Lake Attawapiskat areas. As in the case of the preceding species, probably found throughout the whole area in suitable habitats.

Esox lucius Linnaeus.—Very common in suitable lakes throughout; in the Favourable Lake area, taken in Sandy, South Trout, Favourable and Deer lakes and Duck River; common in Lake Attawapiskat; not so common in the swift waters of the Severn River.

Lota maculosa (Le Sueur).—Common throughout the Favourable Lake area; adults taken in Lake Attawapiskat and Severn River; young taken in small streams in latter two areas.

Percopsis omiscomaycus (Walbaum).—Found in all three areas investigated; common in South Trout Lake (Favourable Lake area) and Lake Attawapiskat; taken also in Severn River and in a small, boggy, tributary stream.

Eucalia inconstans (Kirtland).—Fairly common in boggy situations in Fort Severn area; although not taken in Favourable Lake and Lake Attawapiskat areas undoubtedly found in suitable habitats throughout the area.

Pungitius pungitius (Linnaeus).—Found in Lake Attawapiskat and in Fort Severn area; in the latter area fairly common near the coast in small pools on the barrens.

Perca flavescens (Mitchill).—Found in Favourable Lake area in South Trout, Sandy and North Wind and Favourable lakes and in Lake Attawapiskat; not recorded from Fort Severn area.

Stizostedion vitreum (Mitchill).—Fairly common in Sandy and South Trout lakes in Favourable Lake area and in Lake Attawapiskat; apparently not common in Fort Severn area, only six specimens taken in five weeks collecting and these all in poor condition.

Stizostedion canadense (Smith).—Quite common in Lake Attawapiskat; one specimen from Setting Net Lake (Favourable Lake area).

Percina caprodes (Rafinesque).—Quite common in Lake Attawapiskat; also collected in Duck River (Favourable Lake area) and in Severn River but apparently far less common.

Boleosoma nigrum (Rafinesque).—As in the case of *Percina caprodes* quite common in Lake Attawapiskat but rarer in Favourable Lake area (South Trout Lake) and Severn River.

Poecilichthys exilis (Girard).—Not recorded from Favorable Lake area nor from Severn River; only one specimen, a brilliantly colored male, taken in Lake Attawapiskat.

Imostoma shumardi (Girard).—Fairly common in the Drinking Marten River in Lake Attawapiskat area.

Cottus cognatus Richardson.—Found in all three areas investigated, Favourable Lake area (Setting Net Creek), Lake Attawapiskat and Severn River.

Cottus ricei Nelson.—Two specimens taken from mouth of swift streams flowing into Severn River.

Oncocottus quadricornis (Linnaeus).—One specimen from mouth of Severn River.

ROYAL ONTARIO MUSEUM OF ZOOLOGY, TORONTO, ONTARIO.

Certain Afro-American Geckos of the Genus *Hemidactylus*

By ARTHUR LOVERIDGE

RECENTLY, while attempting a revision of the African Gekkonidae, I had occasion to investigate the status of certain African species which have spread to the New World, apparently through human agency. Other members of the genus occurring in South America are not considered here. The three West Indian species involved may be distinguished as follows:

A. Distance from end of snout to anterior border of eye equal to, or but *slightly* longer than, the distance from posterior border of eye to posterior border of ear-opening; dorsal tubercles strongly keeled.

B. 4–6 lamellae under first toe, 7–9 under fourth toe; males with 20–36 preano-femoral pores ..... *brookii haitianus*

BB. 6–8 lamellae under first toe, 9–10 under fourth toe; males with 3–10 preanal pores ..... *turcicus turcicus*

AA. Distance from end of snout to anterior border of eye *much* longer than the distance from posterior border of eye to posterior border of ear-opening; dorsal tubercles feebly keeled, striate or smooth; 5–6 lamellae under first toe, 7–9 under fourth toe; males with 24–41 preano-femoral pores ..... *mabouia*

In two of the above species the range of pores is greater in Africa, perhaps because of the more abundant material, thus African *mabouia* have 24–54 and the African *brookii angulatus* have 20–46. Because relatively few examples of *t. turcicus* have been taken in the New World, the range given is the maximum for the typical form. If *sinaitus* Boulenger be merged with the typical form, then the lamellae under the first toe are 5–8 in the Red Sea littoral.

The arrival in the New World of two of these species has been so recent as not to have permitted subspecific differentiation. *Hemidactylus brookii* Gray, on the other hand, does appear to exhibit recognizable forms, and it is in the hope that others may test its validity that I offer the following key, based on the extensive material in the Museum of Comparative Zoology.

KEY TO THE GEOGRAPHICAL FORMS OF *Hemidactylus brookii*

1. Preano-femoral pores of adult[1] males normally *less* than 26 (13+13); range—Asia.. 2
   Preano-femoral pores of adult males normally more than 26 (13+13), though ranging from 20 (10+10) to 46 (23+23); range—Africa; West Indies; South America 3
2. Size smaller (40 largest adults in M.C.Z. range from 40 to 55 mm. from snout to anus, average 45.7 mm.); pores of adult males 10 (5+5) to 26 (13+13); tubercles on tail less spinose; range—India, southern Burma; East Indies, etc.....*b. brookii*
   Size larger (3 known specimens from Tsagain and Fort Ava range from 62 to 63 mm. from snout to anus); pores of adult males 12 (6+6) to 16 (8+8); tubercles on tail very long and spinose; range—northern Burma.....*b. subtriedroides*
3. Size larger (40 largest adults in M.C.Z. range from 51 to 69 mm. from snout to anus,[2] average 59.6 mm.); usually 8 (4+4) tubercles on fourth[3] caudal verticil; tubercles along dorsolateral line trihedral; upper labials fewer, average 8; range—trans-Africa and adjacent islands .....*b. angulatus*
   Size larger (40 largest adults in M.C.Z. range from 51 to 69 mm. from snout to anus, average 59.6 mm.); usually 6 (3+3) tubercles on fourth caudal verticil; tubercles along dorsolateral line somewhat flattened; upper labials more numerous, average 10; range—West Indies and South America.....*b. haitianus*

The extensive synonymy of these forms is set forth below.

Hemidactylus brookii brookii Gray

Hemidactylus brookii Gray, Cat. Liz. Brit. Mus., 1845: 153.—Borneo (restricted) and Australia (error).

Gecko tytleri Tytler, Jour. Asiatic Soc. Bengal, 33, 1864: 547.—Moulmein, Burma.

Hemidactylus Gleadowi Murray, Zool. Sind, 1884: 360, pl. ix, fig. 31.—Rantah Forests, Jerruck Division, Sind, India.

Hemidactylus kushmorensis Murray, Ann. Mag. Nat. Hist., 14 (5), 1884: 109.—Bhaner, Upper Sind, India.

Hemidactylus murrayi Gleadow, Journ. Bombay Nat. Hist. Soc., 2, 1887: 49.—Pimpri and Garvi, etc., near Surat, India.

Hemidactylus Tenkatei Lidth de Jeude, Notes Leyden Mus., 16, 1895: 121.—Rotti, East Indian Archipelago.

RANGE.—India and Ceylon east to Assam and Burma. Presumably introduced in Malay Peninsula (Singapore only, *fide* Malcolm Smith), Borneo, and on certain islands of the Dutch East Indies.

Hemidactylus brookii subtriedroides Annandale

Hemidactylus subtriedroides Annadale, Ann. Mag. Nat. Hist., 15, 7, 1905: 29—Tsagain, Upper Burma.

RANGE.—Upper Burma (Tsagain to Fort Ava, near Mandalay; the occurrence of both forms in Burma requires clarification).

Hemidactylus brookii angulatus Hallowell

Hemidactylus angulatus Hallowell, Proc. Acad. Nat. Sci. Philad., 1852: 63, fig.—West Coast of Africa, i.e., Gabon.

[1] Adult because in juveniles they are incompletely developed and the numbers consequently lower, very occasional (diseased?) adults have the number far below the normal, e.g., 3+3 in an adult male (M.C.Z. 34941) from Irumu, Belgian Congo.

[2] Length is given from snout to anus as tails are so often regenerated or damaged. It should be remembered, however, that the tail is usually equal to, or longer than, the head and body, so that the difference in size is actually double that which appears above or more than a quarter the length of the gecko. Nor is 67–69 mm. unusually large for African geckos, such being recorded from Uganda, Kenya, Tanganyika, etc. By a curious coincidence the ranges of African and New World geckos were identical, as were the resultant averages.

[3] Fourth caudal verticil because the three anterior verticils usually have at least one supernumerary row. To find 6 posteriorly on an African gecko is as unusual as to find 8 posteriorly on an Indian specimen.

Hemidactylus guineensis Peters, Monatsb. Akad. Wiss. Berlin, 1868: 640.—Ada Foah, Guinea, i.e., ? Adafer, Mauretania, French West Africa.
Hemidactylus affinis Steindachner, Sitz. Akad. Wiss. Wein, 62, 1870: 328.—Dagana and Goree, Senegal.
Hemidactylus stellatus Boulenger, Cat. Liz. Brit. Mus., 1, 1885: 130, pl. xii, fig. 1.—Gambia and West Africa.
Hemidactylus Bayonii Bocage, Jorn. Sci. Lisboa, 3 (2), 1893: 116.—Dondo, Quanza River, Angola.
Hemidactylus brookii var. *Togoensis* Werner, Verh. Ges. Zool. Bot. Wien, 47, 1897: 397.—Atakpame, Togo.

RANGE.—Anglo-Egyptian Sudan south to Tanganyika Territory, west through Uganda and Belgian Congo to Angola and French Congo, northwest to Senegal and the Cape Verde Islands.

Hemidactylus brookii haitianus Meerwarth

Hemidactylus brookii haitianus Meerwarth, Mitt. Naturhist. Mus. Hamburg, 18, 1901: 17.—Port au Prince, Haiti.

RANGE.—Puerto Rico; Dominican Republic; Venezuela; Colombia, etc.

It might be pointed out that in Dr. D. Cochran's (U. S. Nat. Mus. Bull. 177, 1941: 92, fig. 30) figure of "*brookii,*" while the proportions in the side view really represent that species, those in the view from above are the proportions of *mabouia,* i.e., distance from end of snout to eye is *much* greater than the distance from eye to ear; both drawings, however, are said to represent the same gecko (U.S.N.M. 65782). I did not find the pore character used in the key (p. 91) sufficiently reliable to be employed in differentiating the two species.

Hemidactylus turcicus turcicus (Linnaeus)

Lacerta turcica Linnaeus, Syst. Nat., ed. 10, 1, 1758: 202.—Orient.
Gecus Cyanodactylus Rafinesque, Caratt. Nuovi Gen. Spec. An. Sicilia, 1810: 9.—Sicily.
Gecko meridionalis Risso, Hist. Nat. Europ. Merid., 3, 1826: 87.—Southern Europe.
Hemidactylus granosus Heyden, in Rüppell, Atlas N. Afrika, Rept., 1827: 17, pl. v, fig. 1.—Egypt; Abyssinia; Arabia.
Hemidactylus robustns (*sic*) Heyden, in Rüppell, *loc. cit.*, 1827: 19.—Abyssinia (*fide* Mertens, 1922).
Gecko verruculatus Cuvier, Regne Animal., 2, 1829: 54.—Provence, France; Italy; Sicily.
Gecko verrucosus Gray, in Griffith, Animal Kingdom, 9, Syn., 1831: 50. (Emended spelling of Cuvier's name.)
Hemidactylus karachiensis Murray, Vert. Zool. Sind., 1884: 361, pl. ix, fig. 2.—Sind, India.
Hemidactylus sinaitus Boulenger, Cat. Liz. Brit. Mus., 1, 1885: 126.—Mount Sinai, Egypt.
Hemidactylus exsul Barbour and Cole, Bull. Mus. Comp. Zool., 50, 1906: 148.—Progreso, Yucatan.

RANGE.—Sind and Persia west to the borders of the Red Sea; Socotra Island and Italian Somaliland (where it meets with *H. t. macropholis*) north to Egypt and west round Mediterranean Basin to Morocco and the Canary Islands; Cuba; Florida; Yucatan. A distribution largely attributable to human agency.

Hemidactylus turcicus macropholis Boulenger

Hemidactylus macropholis Boulenger, Ann. Mus. Civ. Stor. Nat. Genova, 17 (2), 1896: 7, pl. 1, figs. 2–2c.—Dolo, Italian Somaliland.

RANGE.—British and Italian Somaliland west to Ethiopia and south to northern Kenya Colony.

Hemidactylus turcicus yerburii Anderson

Hemidactylus yerburii Anderson, Proc. Zool. Soc. London, 1895: 636, 640, pl. xxxvi, fig. 1.—Lahej and Haithalhim, Arabia.

RANGE.—Southern Arabia.

Hemidactylus mabouia (Jonnès)

Gecko Mabouia Moreau de Jonnès, Bull. Soc. Philom. Paris, 1818: 138.—Antilles and adjacent mainland.

Gecko tuberculosus Raddi, Soc. Ital. Sci., 19, 1823: 63.—Warmer climates throughout world, even remote oceanic islands.

Gecko aculeatus Spix, Animalia Nova Novae Lacerta, 1825: 16, pl. xviii, fig. 3.—Rio de Janeiro, Brazil.

Gecko cruciger Spix, *ibid.*, 1825: 16, pl. xiii, fig. 3.—Bahia, Brazil.

Thecadactylus pollicaris Spix, *ibid.*, 1825: 17, pl. xviii, fig. 2.—Bahia, Brazil.

Gekko incanescens Wied, Beitr. Naturg. Brasilien, 1, 1825: 101.—Brazil.

Gekko armatus Wied, *ibid.*, 1825: 104.—Brazil.

Hemidactylus mercatorius Gray, Zool. Miscellany, 1842: 58.—Madagascar.

Hemidactylus platycephalus Peters, Ber. Akad. Wiss. Berlin, 1854: 615.—Coast n. of Mozambique; Johanna, i.e., Anjouan Island.

Hemidactylus Sakalava Grandidier, Revue Mag. Zool., 19 (2), 1867: 233.—Tulear, Madagascar.

Hemidactylus frenatus var. *calabaricus* Boettger, Ber. Offenb. Ver. Naturk., 17–18, 1879: 1.—Old Calabar, Nigeria.

Hemidactylus benguellensis Bocage, Jorn. Sci. Lisboa, 3 (2), 1893: 115.—Cahata, Benguela, Angola.

Hemidactylus tasmani Hewitt, Ann. Natal Mus., 7, 1932: 120.—Driefontein, near Gwelo, southern Rhodesia.

RANGE.—Madagascar; Italian Somaliland (possibly Eritrea and Ethiopa also), south to Zululand, northwest through Transvaal and Bechuanaland to Angola, thence north and northwest to Liberia (in West Africa, however, the distribution is spotty, presumably due to introduction at ports); West Indies; Mexico; South America.

MUSEUM OF COMPARATIVE ZOOLOGY, CAMBRIDGE, MASSACHUSETTS.

The Extraction and Processing of Snake Venom

By ROSS ALLEN and EUGENE MAIER

SNAKE venom is now being used in medical circles for a number of therapies, and it seems worthwhile to record the methods and problems encountered in securing and processing venom. Thus far, medical research has found that the venom of the moccasin (*Agkistrodon piscivorus*) is an anti-haemorrhagic; that of the cobras (*Naja* spp.) has been used as an analgesic for cancer, and that of the fer-de-lance (*Bothrops atrox*) as a local coagulent.

Venom from the coral snake (*Micrurus fulvius*) and copperhead (*Agkistrodon mokasen*) has been effective as a local coagulent and in the treatment of epilepsy, neurasthenia, chorea, and shell-shock.

Experience over a number of years has shown that the production of venom is anything but a simple procedure, and the problems which have appeared during that time should be of interest. All factors in the procurement of venom must be controllable, and to obtain satisfactory yields of venom the snakes must be in good physical condition. Specimens with sore or cancerous mouths are unsuitable, and those that have been injured in catching or captivity are also rejected because they might yield a bloody or murky venom which, when mixed with good venom, would spoil the entire lot. Therefore, only snakes brought in by experienced catchers are used. The pens in which the specimens are housed are as aseptic and as suitable to the snakes' welfare as possible. Trial and error has indicated that a concrete pen with the floor partially covered with rugs and mats is practical. The floor space must be large, in relation to the number of snakes penned, so that they may move with freedom. The pen floor is surrounded by a shallow water moat and retaining wall of concrete. A roof is provided so that the overhead sun does not enter the enclosure.

The venom "milking" apparatus is centered in the pen and consists of a combination table and cage 3 feet high, its top 4 feet by 4 feet. In the center of this box-like table is a hole through which the snakes are dropped after extraction of their venom. This procedure is followed in order that the snakes milked may be marked to indicate that they have been used and to insure the reptiles' being milked only three times as a maximum. After one to three milkings, the snakes are transferred to exhibition pens and fed. They are never milked again. Rattlesnakes are milked only once.

Fastened to the edges of the milking tables are conical graduates for the collection of venom from the snakes. Petri dishes are used for the dehydration process, and a snake hook completes the list of the apparatus used in the milking. All utensils and containers are thoroughly cleaned and sterilized before each milking to insure a minimum contamination from bacteria and foreign matter.

In milking pit vipers, the reptile is grasped firmly back of the head and the head advanced toward the lip of the graduate. As soon as the snake feels the lip of the graduate it opens its mouth and the head is moved so that the fangs hook over the lip. Care is taken to see that the delicate membrane sheath covering the fangs has been drawn back so that it will not be bruised by contact with the glass. With the fangs fully extended and hooked over the graduate, the tips of the middle finger and thumb of the free hand grasp the snake's head behind the temporal region where the poison gland lies and then pressure is gently exerted in a forward motion toward the nostrils. This forces the venom from the sac through the duct that connects with the hollow orifice at the base of the fang. Thus the venom flows from the opening at the tip of the fang and is collected in the bottom of the graduate, and the snake is released into the milking table for later marking and record.

The venom must be processed immediately because snake venom oxidizes rapidly and loses its potency if exposed to air for any length of time.

Therefore, it is either immediately put through a dehydrating process that reduces the liquid to a semi-crystalline substance, or it is placed in a preservative without dehydration. The venom is then stored in dark tightly closed glass bottles to insure a minimum deterioration from air and sunlight. It is of prime importance that all storage containers be sterile because the venom, being a protein, is readily broken down by bacterial action.

Venom from adult reptiles is a yellow viscid liquid which looks somewhat like orange juice and dries into pale yellow crystals. The venom from juvenile specimens is almost colorless and of a much thinner consistency. Such clear venom may be found in rattlesnakes 3 feet in length, and it has been found that this type of venom is far more potent than that of the adult snake.[1]

The manner of milking coral snakes differs considerably, and it was not until 1940 that the senior author, with the help of Dr. Maier, worked out a satisfactory method. The coral snake's fangs are very short, the amount of venom produced is very small, the venom dries rapidly, and its recovery from the milking container accordingly more difficult. However, by permitting the coral snake to chew, in a characteristic manner, on the lip of a 4 cc. vial which is partially filled with a preservative, all the venom produced is recovered. It is then routine laboratory procedure to separate the venom from the preservative later on.

Snake venom, after extraction, may be placed in cold thermos bottles and rushed to the laboratory for the manufacture of medicinal preparations. There it is transferred into a semi-crystalline state for stability. Solutions with sterile distilled water for further processing are made. The liquid venom is placed in a high speed centrifuge and run for 90 minutes at 5000 revolutions per minute in order to separate possible contaminating bacteria from the venom. The venom is then dissolved and dehydrated repeatedly under high vacuum for further purification. The semi-crystals obtained in this process are pulverized into a fine powder and kept in sealed containers as the stock from which the final clinical product is made. The product is marketed either in liquid or dehydrated form. In the latter case, the venom appears as a white fluffy powder, which dissolves rapidly in a diluent contained in a separate vial. The product is dated, with an expiration period of one year from the time of release for the liquid venom. The dehydrated venom is good for at least five years, but should be used within one year after the diluent has been added. The ready product is standardized and assayed on the mouse by injecting the venom into the peritoneal cavity. Skin tests are made on the shaved skin of guinea pigs and rabbits. Both products are made under a special government license.

The milking process herein described was evolved in 1933, after the senior author, beginning in 1927, had milked many thousand snakes of various species. In 1933, scientific institutions and drug manufacturers began enquiries for a standard venom product for experimental use, and the demand for snake venom has grown materially since then. After acquiring a certain proficiency in milking technique, a surprising number of snakes can be milked in a short time. The senior author has extracted the venom from cottonmouth moccasins, *Agkistrodon piscivorus*, at the rate of six snakes per minute,

[1] Proceedings of the Florida Academy of Sciences, 2, 1937.

and as many as one hundred and fifty specimens have been milked in forty four and one half minutes. The largest yield from an individual cottonmouth was 2.5 cc. of venom from a 5-foot specimen.

Rattlesnakes are somewhat more difficult to handle and extraction at the rate of two or three per minute is probably the maximum. The record venom yield from one rattlesnake was 4.5 cc. from a 6-foot specimen of *Crotalus adamanteus*.

The following tables give some comparative data as to the yield of venom from various species of snakes. This compilation is a random selection of records which have been kept since 1934.

Crotalus adamanteus

Date	No. of Snakes	Yield Cubic Centimeters	Yield Grams	
December 30, 1934	22	....	7.65	
January 6, 1935	5	....	2.35	
January 13, 1935	13	....	5.00	
January 20, 1935	18	....	5.90	
January 17, 1936	34	45.	....	
November 1, 1936	20	27.	....	
June 7, 1936	27	40.5	10.00	
January 3, 1937	18	42.	....	
January 17, 1937	52	180.	....	
January 31, 1937	29	86.	....	
March 28, 1937	12	30.	....	
November 14, 1937	15	20.	....	
December 5, 1937	26	30.	....	
January 16, 1938	29	24.	....	
March 27, 1938	12	20.	....	Average size 4 ft. First milking
April 14, 1938	34	38.	....	First milking
April 10, 1938	40	50.	....	
January 8, 1940	45	50.	....	
January 1, 1941	23	50.	13.90	Average size 4½ ft.
Juvenile *C. adamanteus*, one week old. Total weight of snakes 3½ lbs.				
September 24, 1936	20	....	.270	Venom clear and colorless
Crotalus atrox				
July 18, 1937	24	25.	5.52	Snakes 3 to 4 ft.
Sistrurus miliarius barbouri				
October 24, 1937	66	4.	....	
September 16, 1938	41	5.5	1.4	
September 24, 1938	13	....	.42	
Agkistrodon piscivorus				
December 30, 1934	32	....	4.55	
January 6, 1935	50	30.	6.15	
January 13, 1935	46	....	3.10	
February 3, 1935	4	....	1.65	
February 10, 1935	19	....	2.5	
February 17, 1935	41	....	9.4	
March 3, 1935	52	....	8.9	
April 7, 1935	147	....	30.6	
November 1, 1936	39	20.	....	
November 8, 1936	50	50.	....	
January 24, 1937	76	88.	....	
February 7, 1937	40	35.	....	
June 27, 1937	100	60.	23.0	
July 25, 1937	150	112.	29.90	
August 8, 1937	40	25.	....	
October 24, 1937	35	35.	....	
Agkistrodon mokasen				
September 20, 1938	7	1.5	.30	

SUMMARY

From these tables it is apparent that the average yield of venom, dry weight, from each moccasin milked is approximately .171 grams. From every rattlesnake approximately .415 grams of crystalline venom was obtained. These figures include those snakes milked which produced little or no venom, as all the snakes were counted in order to obtain average results, they are based on an over-all average and are not compiled from record yields. It is estimated that approximately ten percent of the snakes milked produce no venom at all because of previous expenditures due to biting themselves, other snakes, or other objects.

We are grateful to the following people for their help in compiling this paper: Eleanor Allen, Edith Allen, Lear Grimmer, Kenneth Freeman, Dr. Thomas Githens, William Patterson, Herman Heller, Virginia Allen, and the senior author's mother, Florence Allen.

SILVER SPRINGS and VENICE, FLORIDA.

Comments on Piatt's Terminology in Salamander Myology

By H. LEIGHTON KESTEVEN

IN the second of his two communications under the above caption Piatt (1940) suggests the adoption of two designations which, though quite satisfactory as applied to the muscles of the salamanders, are open to certain objections.

A.) INTERHYOIDEUS POSTERIOR.—There are two objections to this designation for the posterior of the two ventral superficial muscles of the hyoid segment. Firstly this muscle is never an interhyoid muscle, and secondly the name is not applicable to the homologue of the muscle in other vertebrates.

In the branchial segments of the elasmobranchs the constrictor muscles overlap one another, so that each superficial constrictor overlies the deep constrictor of the segment next behind it.

In the hyoid segment the reduction of the cleft and the modification of the hyoid visceral arch have resulted in the almost complete exposure of the deep constrictor dorsally. There has been no backward growth of the anterior wall of the cleft in front to cover it. Inferiorly, however, although the cleft is entirely absent, the deep constrictor grows forward beneath the superficial constrictor in front of it. This deep constrictor is the M. interhyoideus, interhyoideus anterior of Piatt. It is quite continuous posteriorly with the superficial constrictor. This last is the the Csv2 of Vetter (1874), interhyoideus

posterior of Piatt, and it is serially homologous with the superficial constrictors behind it, and with the Csv1, M. intermandibularis, in front of it.

The deep hyoid constrictor is well named 'interhyoideus.' It arises on each side from the ceratohyal and is inserted into the midventral raphe deep to the Csv1.

The superficial constrictor, on the other hand, never takes its origin from the hyoid arch but arises from the dorsal fascia.

Throughout the whole of the Anamniota it is possible to recognize the same two components of the primitive hyoid constrictor sheet. In the Dipnoi and Amphibia conditions are essentially the same as in the Elasmobranchia and as described and figured by Piatt. The M. interhyoideus is not developed in some lacertilians, but in the great majority of the Reptilia both muscles may be recognized. The antero-dorsal portion of the Cs2 has given rise to the M. depressor mandibulae in all these forms except the Dipnoi. The remainder of the sheet remains almost unchanged. In the reptiles and birds, however, the two portions are never continuous at their edges; always the anterior edge of the Csv2 lies superficially to the posterior edge of the M. interhyoideus. The Csv2 always takes its origin from the fascia dorsalis, and is always inserted into the midventral raphe. In varanid lizards, in most scincs and in the Ophidia the fibres of the Csv2 sweep forward so as to terminate between the posterior ends of mandibular rami, and in this situation they lie superficially to the posterior fasciculi of the Csv1. The M. interhyoideus in the majority of reptiles arises from the hyoid cornua. At times, however, in reptiles, and always in birds the muscle takes its origin from the posterior end of the mandible below the insertion of the M. depressor mandibulae.

Vetter's numerical designation has been used by the majority of workers since his work appeared. It was slightly modified by Tiesing (1895) and again by Marion (1905) and has very recently been amplified by Lightoller (1939). Translated into words Csv2 will be read as 'superficial ventral hyoid constrictor,' a designation which at once places the muscle in its correct category and at the same time takes cognizance of its homology with the Csv2 in all the other Vertebrata.

It is submitted that, inasmuch as the muscle does not present either origin or insertion into the hyoid arch, the designation 'interhyoideus posterior' is a misnomer even in salamanders.

B.) INTERMANDIBULARIS ANTERIOR.—It is not certain who first designated the little muscle immediately behind the symphysis menti in the Amphibia, the submentalis muscle, but that designation has been used by several workers and is preferable to the name 'intermandibularis anterior,' which has been used by a number of other workers and which is regarded by Piatt as the correct name for the muscle.

The M. submentalis is really a much more important muscle than has been supposed in the past.

The araphic anterior portion of the Csv1 first makes its appearance in certain of the plagiostomes. In the teleostomes it is probably the most constant 'intermandibular' muscle. The greater portion of the Csv1 has been combined with an anterior portion of the Csv2 to form the M. protractor

hyoidei. There is reason to believe that in those fishes in which the much reduced "intermandibularis" muscle is composed of fibres inserted into the mid-ventral raphe it is in verity not an intermandibularis but a submentalis muscle. This is probable in view of the fact that, as in amphibians, the muscle is more deeply placed than is the true M. intermandibularis.

Throughout the Amphibia the M. submentalis is of very general occurrence, and is always araphic, and placed more deeply than is the M. intermandibularis behind it.

Although it appears never to have been recognized in any of the Sauropsida by previous investigators, it is a fact that the M. submentalis is present in all reptiles and in not a few birds. The muscle is always small, except in the Crocodilia, and is always placed more deeply than is the M. intermandibularis. Its fibres may be, and commonly are, araphic, or they may be inserted into a median raphe, and then commonly take an oblique direction. In the Ophidia they run nearly antero-posteriorly.

The deep situation of this muscle in the majority of the Vertebrata strongly suggests that it is "rest" of the deep ventral constrictor of the mandibular segment.

The situation of the muscle deep to the insertion of the longitudinal branchio-mandibular muscles in the Sauropsida is of importance, for it suggests that it is this M. submentalis and not the M. intermandibularis which gives rise to the M. mylohoideus in the Theria, for this last muscle is very definitely placed upon a deeper plane than is the intermandibular muscle of the Anamniota.

Amplifying Vetter's numerical designation, the submentalis may be regarded as the Csv 1a and the intermandibularis as the Csv 1b. The designation 'submentalis' seems to the writer preferable to 'intermandibularis anterior' because it confers upon the muscle that definite entity which its persistence throughout the vertebrate series calls for. The designation has the added advantage of "locating" the muscle correctly and accurately.

Literature Cited

Lightoller, G. H. S.
1939 Probable homologues. A study of the comparative anatomy of the mandibular and hyoid arches and their musculature. *Trans. Zool. Soc. London*, 24: 349–444, 2 figs., 9 pl.

Marion, G. E.
1905 Mandibular and pharyngeal muscles of *Acanthias* and *Raia*. *Amer. Nat.*, 39: 891–920, 15 figs.

Piatt, Jean
1940 Correct terminology in salamander myology. II. Transverse ventral throat musculature. Copeia, 1940: 9–14, 2 figs.

Tiesing, B.
1896 Ein Beitrag zur Kenntnis der Augen-, Kiefer- und Kiemenmuskulatur der Haie und Rochen. *Jena Zeitschr. Naturw.*, 30: 75–126, pl. 5–7.

Vetter, B.
1874 Untersuchungen zur vergleichenden Anatomie der Kiemen- und Kiefer-muskulatur der Fische. *Jena Zeitschr. Naturw.*, 8: 405; 12: 431.

Redmyre Rd., Strathfield, Sydney, N.S.W.

Mating Behavior in *Triturus torosus* and Related Newts

By Robert Emrie Smith

Introduction

PREVIOUS accounts of the natural history of *Triturus torosus* have given little information concerning its mating habits. Ritter (1897), Schreitmüller (1909) and Storer (1925) described the amplectic posture and some of the more general aspects of mating behavior. There is no record of the mode of insemination, nor is there any reference to the function of glandular mechanisms in the courtship pattern. Recent studies on other urodeles enabled Noble (1931a) to develop the thesis that phylogenetic relationships appear in the mating patterns of the several families of the order. It is the purpose of this paper to record the phenomena of mating in *Triturus torosus* and to interpret them as far as possible in the light of present knowledge and the attendant theories of urodele mating behavior.

The procedure employed in the present work has entailed the observation of breeding adults under both natural and laboratory conditions. In studying the glands contributing to the mating act, tissues were fixed in Bouin's or Zenker formol, embedded in nitrocellulose and sectioned to 10 *mu*. Stains used included Harris' hematoxylin and eosin, Koneff's iron-hematoxylin-anilin-blue (Koneff, 1936), and I.H.A.B. with methyl green (Koneff, unpublished). A few slides were stained in Mallory Azan.

Preliminary Activity at Breeding Sites

Near the beginning of the mating season male newts congregate at breeding ponds, concurrently assuming the smooth skin, broad tail and enlarged cloaca characteristic of the nuptial stage. The females arrive later and are easily distinguished by their smaller size, granular skin and absence of the tail fin. During the early part of the season numerous males may be seen resting on the floor of the pond or roving about in shallow water, their attention apparently directed toward the shore. The females are usually seized as they enter the water. In this initial phase the scarcity of females combined with the high degree of sexual ardor among the males often results in the formation of tangled masses of males surrounding single females. Generalized excitement of this type appears to depend upon the presence of a female or an amplectic pair. Ordinarily the male *torosus* discriminates sex readily and rarely embraces another male. In the ponds females are seized by males as a consequence either of direct contact with the male or of a sudden movement near one. Although the mechanism of this perception has not been studied, it appears likely that mechanical agitation of the medium is one of the primary stimuli to the clasping reflex. Males ranging along the shallows have been induced to embrace foreign objects, such as a finger or a stick of suitable size, which were oscillated while being moved toward or near them through the water. It is well to distinguish the foregoing type of stimulus from that which elicits, in either sex, a stereotropic clasping response. The latter results from any mechanical pressure stimulus applied directly to the ventral pectoral or pelvic region of the animal (see Main, 1931) and is not regarded as the initial stimulus to clasping in breeding males.

Courtship

The more general features of the amplectic posture have been described elsewhere (Ritter, 1897; Schreitmüller, 1909; and Storer, 1925) and may be summarized as follows: there is a basic posture in which the male, assuming a dorsal position, clasps his forelegs around the female immediately posterior to the pectoral girdle. The hind legs of the male may hang free or be pressed across the cloacal or pelvic region of the female; the position of the hind legs varies in different pairs and stages of mating. The lateral lips of the male cloaca become distended to form a saddle over the dorsum of the female.

With this preliminary orientation a period of courting [1] follows. During amplexus the male rubs his cloaca laterally and axially across the dorsum of the female, while exerting a characteristic clutching reflex in which the hind feet contract across the ventral surface of the female around her cloacal region. In some pairs this act involves the stroking of only the femoral and tibio-fibular regions, while in others it may be extended to include the abdomen as well. The frequency of the reflex increases with sexual excitement and at its height may reach 70 or 80 contractions per minute. The function is probably that of excitation, for it is concurrent with the lateral separation of the female cloacal lips which precedes reception of the spermatophore. Regardless of its function, the stimulus to the reflex appears to be a mechanical one resulting from the repetitive contact between the pelvic region of the male and the dorsum of the female.

Still another feature to be noted is the pronounced tendency of the amplectic male to hook its chin over the rostrum of the female. This is accomplished by a cervical flexure with a simultaneous opening of the jaws so as to bring the intermandibular region over the snout of the female. The male may then exert a lateral wagging movement of the head, and in so doing rub the snout of the female. At the height of sexual excitement this action takes place in bursts of ten or twelve rapid "wags," usually accompanied by vigorous undulations of the tail. The energy of both these movements tends to increase during the progress of amplexus. Numerous observations suggest a relationship between the intensity of this head movement in the male and the eventual behavior of the female during spermatophore deposition.

Deposition and Reception of the Spermatophore

Insemination following successful courtship was first observed on March 30, 1937, in a pair of *Triturus torosus* taken the previous day from a reservoir near Berkeley, California. This pair was found in amplexus in the laboratory at 9:45 A.M. and remained in this condition for the next hour or longer. During that time the cloaca of the male became typically enlarged. At 10.30 A.M. the cloaca of the female was somewhat distended; the groove between the labia was noted to be 2 or 3 millimeters in width.

The subsequent details of this mating have since proven typical and may be illustrated by excerpts from the laboratory notes taken at the time:—

10:45 A.M.: intermittent outbreaks of spasmodic movements and swimming by the male while embracing the female.

[1] The total time in amplexus is extremely variable. Insemination may be effected within two or three hours, but in several instances captive pairs under continuous observation have remained in amplexus eight and ten hours, and intermittently for two or three days.

10:53 A.M.: male crawls over left side of female's head, flattens cloaca against substratum, vibrates tail and hind legs with general shuddering of pelvic and thoracolumbar regions. Female remains motionless, with snout at distance of 1½ inches or less from cloaca of the male.

10:54 A.M.: male deposits spermatophore on substratum, moves forward two or three inches; female also moves forward and into line with path of the male, continually nosing the male's cloaca; female passes over spermatophore. The sperm capsule, at the apex of the stalk, lightly touches the cloacal groove of the female and sticks firmly between the parted lips.

10:55 A.M.: male continues spasmodic, vibratory movement; female follows male closely but appears to be in a state of tension rather than spasm. In spite of having taken up the sperm during this period, the female has continually fixed all attentions upon the cloacal region of the male. Male turns, ceases clonic spasms, suddenly seizes female and resumes amplectic position.

11:15 A.M.: continued amplexus, male exerting characteristic reflexes, including the chin-hook, head wagging and hind leg clutching reaction. The spermatophore is now flattened out in the cloaca of the female.

Prior to emission of the spermatophore on the substratum the male typically dismounts the female by moving off anteriorly. This may be either directly over the head or off the left side of the shoulder or head region. The male then moves along the substratum in an arc to the right. The female usually follows, her nose directly against the posterior of the male's cloaca, although at times the snout may be approximately an inch away.

During this circuit on the substratum, the male appears to watch the female by constantly turning the head to the right and in her direction. At this time the female may refuse to accept the male by moving away or by remaining entirely unresponsive. If this occurs, the male commonly returns immediately and seizes the female without depositing the spermatophore. This response is especially rapid when the female moves suddenly toward the surface to gulp air, or is disturbed by other animals in the aquarium. Recapture may result in a normal posture or in a reverse relation; that is, the male may approach the female head-on and embrace her dorsally. If this latter position is assumed, the male works his way posteriorly, "hand-over-hand" onto the tail of the female. Here the male pivots deftly through 180° to assume the normal posture without releasing the female at any time. It is of interest to note also that the male returns to the female whether she accepts the spermatophore or not.

Glandular Mechanisms in the Mating Pattern

The rôle of glandular mechanisms in the mating patterns of urodeles has appeared in the last decade as one of the salient problems in comparative physiology. It has been apparent for some time that in the ambystomids and in most newts the glands of the male cloaca furnish a secretion during mating which stimulates the female to pass over and take up the spermatophore after its deposition. The detailed study of Noble and Brady (1933) on *Ambystoma opacum* has rendered a fairly strong argument favoring the abdominal glands as the mediator of this response. This evidence is largely inferential, but since it appears the best available at present it may be summarized as follows: the presence of some powerfully attractive stimulus issuing from the male cloaca is indicated from the fact that the female follows the male during the deposition, keeping her snout near, usually against, the cloaca of the male;

the openings of the abdominal gland in ambystomids, and in some other forms are found to be such that the secretion of the gland is carried outside of the cloacal lumen and thus cannot readily contribute to spermatophore formation, i.e., the gland must liberate its products directly to the external medium; histological studies of both the cloacal structures and the spermatophore show that the abdominal gland does not contribute to the components of the latter.

In the plethodontids, and in *Triturus viridescens,* the functional analogs to the cloacal mediator are the hedonic glands. These have been found in the plethodontids by Noble (1929) who reports them to be of simple structure, resembling ectodermal poison glands, scattered diffusely over various parts of the body or localized in groups on the cheek, the mental pad, or at the base of the tail. The hedonic glands of the newt *Triturus viridescens,* are involuted, tubular structures occurring as a series of pits on the cheek of both sexes. Hilton (1902) seems originally to have demonstrated the structure of the hedonic glands in the latter species and clearly related the function to mating.

From histological and behavioristic studies Noble (1929, 1931b) was able to associate the basic courtship postures of various plethodontids with the presence and location of their hedonic glands. In *Triturus viridescens,* Rogoff (1927) demonstrated that hedonic secretions act through the olfactory sensory channels to render the female quiescent during amplexus. Abdominal glands are well known in this species, and the experiments do not appear to exclude the possibility that these may function in directing the female, once quieted by hedonic glands, to follow the male as it moves to deposit the spermatophore.

In the mating of *Triturus torosus* there is evidence that both hedonic and cloacal secretions are participants, and function in the order named. As in *Ambystoma,* during the deposition of the spermatophore the female follows the male very closely; likewise, the openings of the abdominal glands are external along the postero-lateral margins of the cloacal lumen; and finally, histological preparations of both the cloaca and the spermatophore fail to reveal upon the latter any trace of abdominal gland products. These facts plainly imply the action of a cloacal mediator, which is probably the abdominal gland. From the present studies it is equally apparent that this action is not in itself sufficient to induce the female to accept the spermatophore. That is, the influence of the abdominal gland is apparently dependent upon a period of amplexus during which the female is "conditioned" by means of the secretions from another set of glands, the hedonic, which have been found located under the chin of the breeding male.

It becomes apparent that the presence of hedonic glands would explain certain phenomena characteristic of the mating behavior in *torosus.* It will be recalled that the amplectic male is observed to rub his chin repeatedly across the nostrils of the female, and it appears that insufficient contact of these parts results in failure of the female to follow as the male moves away to deposit the spermatophore. Histological examinations of the skin covering the submandibular region of the male demonstrate a group of glandular cells in that area, distinctly different from the other skin glands of the body. These may be regarded as hedonic glands and in the following paragraphs

will be described in (a) breeding males prior to amplectic activity, (b) breeding males following a prolonged amplexus and (c) in terrestrial males.

(a) The greatest development of the hedonic glands is exhibited by *torosus* males in the height of breeding condition prior to amplexus. In such animals each gland may have several cell types within it. These are chiefly columnar, with eliptical nuclei so oriented that the long axis is parallel to that of the cell; although a few appear pyknotic, most nuclei stain similarly to those of surface epithelium. The cytoplasm contains small basophilic and a few refractive granules. At the height of development the central part of the hedonic gland is jammed with cells. Secretion is of the holocrine type, for the glandular epithelium is usually destroyed during the elaboration and expulsion of the product. The glands are surrounded by what is apparently a myoepithelial capsule which may be instrumental in discharge.

(b) Breeding males after a prolonged amplexus showed marked reduction in size of hedonic glands. These appeared in an exhausted condition and resembled a resting or young gland.

(c) As might be expected, the glands of males in the terrestrial condition appear even less developed than those in the breeding animals after prolonged amplexus.

Hedonic glands are distinguishable from other structures when fully developed. As indicated by Dawson's (1920) comprehensive work, classification of undeveloped glands is difficult, and it is frequently possible to assign their status only according to other glands in the vicinity; similarly, there may be an intermingling of cell types even in mature glands. In the mature condition, hedonic, poison and mucous glands may be distinguished from each other since the poison glands are marked usually by pyknotic nuclei, lack of cell membranes and granular cytoplasm staining grayish color for the most part in I.H.A.B. and methyl green; the mucous glands are bounded by regular columnar epithelium with irregular, proximally placed nuclei, with the lumen usually filled with mucous which stains green with methyl green; and the secretion is apocrine or merocrine in contrast to the holocrine type of the hedonic glands.

Some Phylogenetic Aspects of the Mating Behavior in *Triturus*

The general thesis offered by Dunn (1923) that the breeding habits of urodeles provide valuable criteria in the determination of phylogeny within the order is a basic generalization. He indicated the importance of such data as cloacal structure, mode of fertilization, disposition and parental care of the eggs, and relative size of the vitellus. Thus by suitable comparisons Dunn was able to bring the then unsettled affinities of *Necturus* and *Proteus* into apparent relation with the salamandroids, while *Siren* appeared to be closer to the hynobiids.

More recently Noble (1931a; Noble and Brady, 1933) greatly extended this general scheme to indicate the apparent interrelations as well as the probable course of evolution in the behavior patterns within the order. These appear to conform generally to the phylogenetic relations as otherwise established. Noble (1931a) and Dunn (1931) appear to agree that the suborders of urodeles, Ambystomoidea and Salamandroidea, have most

probably arisen from hynobiid or prehynobiid stock. Of the two, the Ambystomoidea seems to have remained the more primitive in both structure and behavior. Noble (*loc. cit.*) considered ambystomid mating patterns to represent a relict and generalized behavior out of which the courtships of the higher families of urodeles may have evolved. Noble further pointed out (1931a: 388) that the mating patterns of the Salamandridae have arisen largely through the elaboration of one or more of the features now found in the generalized pattern of the ambystomids. With respect to *Triturus,* Noble considered that the closely related *T. pyrrhogaster* and *T. torosus* have emphasized the forelimb amplexus which, according to Mohr (1931), occurs to some extent in a species of *Ambystoma.* Coincident with increasing specialization of mating patterns, is the apparent tendency to supplement the abdominal glands, active in ambystomids and most salamandrids, by functional hedonic glands.

In the genus *Triturus* at least two criteria afford evidence concerning the phylogenetic aspects of mating behavior, the amplectic postures and the glandular activity association with mating. With respect to these features our present knowledge of the mating patterns of certain species of *Triturus* is summarized below.

Triturus torosus in amplexus always employs a firm foreleg embrace with occasional resort to the hindlimbs. Hedonic glands assume the role of initial inhibitor of the female, while abdominal glands appear to direct the female in the reception of the spermatophore.

Triturus rivularis exhibits a definite foreleg embrace, though seemingly less firm than in *torosus*; use of the hindlimbs in this connection has not been observed. Judging only from amplectic behavior, the hedonic and abdominal glands act here as in *torosus.*

Triturus similans, the mating of which is not well known, resembles the previous two species with respect to amplexus and probably glandular activity.

Triturus viridescens, of the eastern United States, is reported to employ solely the hindlimbs for the amplectic embrace (Noble, 1931; *et al.*). Hedonic glands not only act initially to quiet the female but also induce her finally to follow the male and receive the spermatophore as it is deposited (Rogoff, 1927). Abdominal glands are present, but their status in relation to mating is obscure.

According to Klinge (1915), the Asiatic *Triturus pyrrhogaster* has an amplexus involving a partial embrace with one forelimb over the neck and a hindlimb over the back of the female. By rapid undulations of the tail the male is said to direct its cloacal secretions toward the nostrils of the female. This action apparently is sufficient to cause the female to follow the male during spermatophore deposition. That the secretions described are produced by the abdominal glands seems likely, but this can only be inferred. Hedonic glands have not been reported here and the mating behavior gives no suggestion of their presence.

On the basis of Noble's thesis that the ambystomids present a relict and generalized mating pattern, *Triturus pyrrhogaster* would approximate most closely a primitive condition. This is consistent with its mating in that the amplexus is only a partial forelimb embrace, and that cloacal secretions,

presumably of the abdominal glands, assume all of the inhibiting and directing action upon the female during the mating. What is apparently a further stage in the degree of specialization of courtship behavior occurs in *T. torosus* and its geographic associates. Here the foreleg amplexus is complete, and initial inhibition is evidently produced through the activity of hedonic glands, while the final direction of the female to the spermatophore is relegated to the abdominal glands. Accordingly, in *torosus* the abdominal glands appear to have surrendered in part the presumably dual function attributed to them in *pyrrhogaster,* to be replaced in *torosus* by hedonic glands. In *Triturus viridescens* both the hindleg embrace and the presence of highly developed hedonic glands indicate a much greater departure from the generalized pattern than is exhibited in the *pyrrhogaster-torosus* complex. Other differences besides those of morphology and mating are found in its life history and geographic distribution. This is consistent with evidence (Noble, 1931; Dunn, 1931) that *viridescens* has been derived from European stock while *torosus* is of Asiatic affinity. It appears probable that the mating behavior of *torosus* is derived from the same pattern as that of the eastern Asiatic *pyrrhogaster.* By contrast the courtship of *viridescens* suggests an early segregation from a plexus ancestral to the modern *torosus* and *pyrrhogaster.*

Literature Cited

Dawson, A. B.
1920 The integument of *Necturus maculosus. Jour. Morph.,* 34: 487–589.

Dunn, E. R.
1923 The breeding habits of salamanders and their bearing on phylogeny. Copeia, 115: 25–27.
1931 The herpetological fauna of the Americas. *Ibid.,* 1931: 106–119.

Hilton, William A.
1902 A structural feature connected with the mating of *Diemyctylus viridescens. Amer Nat.,* 34: 643–651.

Klinge, Wilhelm
1915 *Triton pyrrhogaster. Wochenshr. Aquar.-Terrar.-Kunde.,* 12: 427–431.

Koneff, A. A.
1936. An iron-hematoxylin-anilin-blue staining method for routine laboratory use. *Anat. Rec.,* 66: 173–179.

Main, Rolland J.
1931 Stereotropism and geotropism of the salamander, *Triturus torosus. Physiol. Zool.,* 4: 409–422.

Mohr, Charles E.
1931 Observations on the early breeding habits of *Ambystoma jeffersonianum* in central Pennsylvania. Copeia, 1931: 102–104.

Noble, G. K.
1929 The relation of courtship to the secondary sexual characters of the two-lined salamander, *Eurycea bislineata* (Green). *Amer. Mus. Nov.,* 362: 1–5.
1931a The biology of the Amphibia. New York, McGraw-Hill: xiii + 577 pp., 174 figs.
1931b The hedonic glands of the plethodontid salamanders and their relation to the sex hormones. *Anat. Rec.,* 48: Suppl., 57–58.

Noble, G. K., and M. K. Brady
1933 Observations on the life history of the marbled salamander, *Ambystoma opacum* Gravenhorst. *Zoologica,* 11: 89–132.

Ritter, W. E.
1897 The life history and habits of the Pacific Coast newt (*Diemyctylus torosus* Esch.). *Proc. Calif. Acad. Sci.,* (3) 1: 73–114, pl. 3.

ROGOFF, J. L.
1927 The hedonic glands of *Triturus viridescens;* a structural and functional study. *Anat. Rec.,* 34: 132–133.
SCHREITMÜLLER, WILHELM
1909 Einiges über Die Liebesspiele und Begattung von *Triton torosus* Eschscholz nebst einer Notiz über *Triturus viridescens* Rafinesque var. (Neu Orleans). *Wochenschr. Aquar.-Terrar.-Kunde.,* 6: (Beilage Lacerta) 102–104.
SMITH, ROBERT EMRIE
1941 The spermatophores of *Triturus torosus* and *Triturus rivularis. Proc. Nat. Acad. Sci.,* 27 (6): 261–264, 1 fig.
STORER, T. I.
1925 A synopsis of the Amphibia of California. *Univ. Calif. Publ. Zool.,* 27: 1–342, pls. 1–18.

DIVISION OF PHYSIOLOGY, MEDICAL SCHOOL, and DEPARTMENT OF ZOOLOGY, UNIVERSITY OF CALIFORNIA, BERKELEY, CALIFORNIA.

Herpetological Notes

CHRYSEMYS FROM NANTUCKET ISLAND.—The writer recently received three adult *Chrysemys* from Nantucket, an island 30 miles eastward from the mainland of Massachusetts. These turtles are of interest in connection with Bishop and Schmidt's paper (1931, The painted turtles of the genus Chrysemys, Field Mus. Nat. Hist., Zool. Ser. 18: 123–139, 27 figs.) in which they roughly limit the area of intergradation between *Chrysemys picta picta* and *C. p. marginata* to the valley of the Hudson River, but add: "How far the area may extend beyond these limits we have not been able to determine."

These three specimens are the first adults to reach the Boston Society's collection. One is a typical *p. picta,* while the other two show the costals alternating with the vertebrals as is characteristic of *p. marginata.* The plastrons of all three are immaculate.

There is but one specimen from Nantucket in the collection of the Museum of Comparative Zoology at Cambridge. This turtle also shows the alternating costal-vertebral arrangement of *p. marginata,* with fairly broad anterior yellow margins. Characters of *p. marginata* thus persist to the eastward. Nantucket Island is believed to have been cut off toward the end of the Wisconsin Ice Cap, estimated at 50,000 years ago.—H. L. BABCOCK, *Boston Society of Natural History, Boston, Massachusetts.*

GASTROPHRYNE CAROLINENSIS IN KENTUCKY.—Although long assumed to occur within the state of Kentucky, there apparently seems to be no published record of the occurrence of the narrow-mouthed frog in the state. On the night of June 9, 1941, while collecting amphibians in the vicinity of Floyd's Station, a few miles east of Bowling Green, Warren Co., Kentucky, it was my good fortune to secure specimens of this frog. Seven were collected out of hundreds present. Their chorus was audible to a considerable distance. There had been a very heavy rain in the late afternoon, sufficient to raise the level of the permanent pond (from which the frogs were collected) about 3 feet. All the specimens except one were collected at the edge of the pond, in the mouths of little gullies cut by the heavy rainfall, in the water with only the anterior portion of the body projecting, and with the front feet resting on the ground at the water's edge. The other specimen was taken from the water in a clump of half-submerged weeds about 3 feet from the shore. Numerous individuals were heard calling out in the pond in the vegetation at varying distances from the shore. Other frogs and toads noted at this locality the same night included *Scaphiopus h. holbrookii, Bufo fowleri,* and *Acris crepitans.*—ROGER W. BARBOUR, *State Department of Conservation, Frankfort, Kentucky.*

VARIATION IN *SONORA TAYLORI*.—During the years from 1933 to 1939 a representative herpetological collection was made in Hidalgo County, Texas, in the Lower Rio Grande Valley. During this time about seventy specimens of the formerly rare *Sonora taylori* (Boulenger) were secured. We are greatly indebted to the following people for a large share of these and other reptiles: John Evrets, Edward Lee Atwood, Clyde Rutherford, Norman Skinner, Walter Schulle, Ruth Caswell, and Frank Champion. While in general this series of *Sonora taylori* shows considerable uniformity, a closer study of the scutellation and of other features reveals interesting differences.

The general color is light to dark brown. In a large number of individuals the anterior and central portions of the dorsal scales are darkened, which gives a longitudinally striped appearance particularly on the sides. The head is usually brown like the body, but in numerous individuals the top of head is partially or entirely much darker than the body.

Scale rows on anterior fifth of body 14, and 13 posteriorly except for the following irregularities observed back of the anterior fourth of body: SM 12, 14-13-14; SM 10 and SM 33, 14–14; SM 815, 14–13–14–13. Stickel (COPEIA, 1938: 183) reported the range of ventrals in males as from 126 to 139. The present series ranges in males from 132 to 144 with an average of 137, and for females 138 to 153 with an average of 146. Caudals range in males from 39 to 50 with an average of 45; in females from 35 to 41 with an average of 38. In the males the caudals number 29.9 percent or more of the number of ventrals, with an average of 33.2 percent; while in females they range under 28.3 percent with an average of 25.8 percent. A study of the tail and body lengths showed that in males the tail was 24 percent of the body length, or more, with an average of 25.5 percent, while in females it was less than 22 percent with an average of 20.5 percent. These appear to be significant secondary sexual characters.

There are two pairs of chin shields, the anterior larger, about twice as long as broad; posterior pair variable, but smaller than the anterior, often separated by gular scales. Upper labials 7–7 except SM 31 which has 6–6, the loss apparently due to fusion of the third and fourth. Lower labials 6–6 except SM 34 which has 7 on the right side. Nostril perforates middle of the entire nasal. Loreal 1–1. SM 19 has nasal and loreal fused. Preoculars 1–1. Postoculars 2–2, except SM 816 and SM 817 which have 1–1. Temporals 1–1 except SM 808 in which the upper labial is fused with the anterior temporal; SM 12 and SM 17, 1–2 on right side; SM 20 and SM 23, 1–2 on both sides. The anal plate is divided.

The largest individual measures 379 mm. This is a male with a midsection diameter of about 8 mm. The average for adults in the collection was less than 300 mm. The smallest specimen measures 99 mm. The head is not wider than the neck, body is circular, anterior two-thirds subequal, from there tapering to the end of the tail. Hemipenes moderately bilobed.

The dentition is as follows: maxillary teeth 12 to 15 with a space preceding the last three which are about one and a half times the length of the anterior series. Careful examination reveals that the last three teeth are definitely grooved, the anterior one often most distinctly. Dentary teeth 11; palatine teeth 9; pterygoid teeth 13.

Sonora taylori (Boulenger) is a burrowing snake which is found most often after hard rains during the spring and summer months. Usually about six eggs are laid, these measuring 20 mm. in length and 6 mm. in diameter.—STANLEY and DOROTHEA MULAIK, *Department of Biology, University of Utah, Salt Lake City, Utah.*

ELAPHE BAIRDI FROM KERR COUNTY, TEXAS.—In 1880 Yarrow described *Coluber bairdi* from Fort Davis, in west Texas. It was later placed in the genus *Elaphe*. Since then few other specimens have come to collectors. During July, 1939, a medium-sized specimen was taken about 12 miles south of Kerrville, Kerr County, Texas, and a young one from Raven Ranch about 8 miles farther south. These are in the Chicago Academy of Science collection. During 1940 two adults and an immature specimen were taken in the same general area and are now in the collection of the authors.

The last three specimens are numbered SM 707, SM 708, and SM 772. Scale counts given for the different individuals will be in the above order. The first two are males and the third a female, a large specimen about 1030 mm. in length with the tail less than 0.24 of the total length. A description of these specimens follows.

Body but little depressed, stout almost to vent, tail narrowing abruptly. Head broad, widest beyond rear of parietals; side of head from edge of rostral along upper labials forming a straight line. Frontal little longer than broad, about as 12 to 11; rear of frontal wider than supraocular at that point (7 to 5).

Scale rows 27–27–19, 25–27–19, 28–27–19; ventrals 242, 255, 234; anal plate divided; caudals 86, 89, 81. Upper labials 8–8, 9–8, 8–8; the seventh largest; lower labials 12–13, 16–14, 13–14; orbit bordering the labials, 4 and 5. Loreal single; preocular single; postoculars 3 except in SM 707 which has a smaller additional one inserted above the posterior corner of the upper postocular. Keels on mid-dorsum moderate, becoming less pronounced on the sides; none on first six rows anteriorly, the smooth scale rows decreasing to the first three rows posteriorly. Apical pits two, distinct, ovate, 0.15 by 0.20 mm. in larger specimens; pits bluish white with minute dark flecks, separated by about twice their width and found on all except first row of scales.

Maxillary teeth 18 in the three specimens; dentary teeth 24, 21, 22; palatine teeth 11, 9, 11; pterygoid teeth 17, 19, 18.

General color above ashy brown, yellowish below, with faint blotches becoming more distinct posteriorly. A series of 40 or more squarish blotches with lighter centers on the back becoming indistinct on the tail; a row of smaller blotches on the sides below the dorsal row.

SM 722, found DOR, contained six eggs ranging in length from 61 to 72 mm., and in diameter from 23 to 26 mm.—STANLEY and DOROTHEA MULAIK, *Department of Biology, University of Utah, Salt Lake City, Utah.*

OBSERVATIONS ON THE BREEDING HABITS OF *BUFO AMERICANUS AMERICANUS*.—In the spring of 1941, mating pairs of *Bufo americanus americanus* were marked by means of the toe clipping method for the purpose of recording movements and mating behavior in this species. A total of 258 toads, 120 mating pairs and 18 non-mating individuals, were marked at Lincoln Pond, a body of water comprising approximately 10 acres on the Edmund Niles Huyck Preserve, Rensselaerville, New York.

It was found that mating and egg-laying occurred at four distinct and separate places in Lincoln Pond. 1) First mating and egg laying began April 20 along the north shore, 2) second mating began April 29 along the east shore, 3) third mating began May 7 along the west shore, 4) fourth mating began May 21 in the north central part of the pond on top of a luxuriant growth of *Elodea* which reached the surface of the water. Mating was almost completed at the first site before it began at the second. The second, third and fourth matings were entirely separate in time from each other and mating and egg laying were completed by at least three days at an earlier site before they began at the next. The temperature, taken on the day when breeding commenced, at each of the four sites was, 1) 23 C., 2) 24.5 C., 3) 25.5 C., 4) 24.5 C. Intervals of marked coldness intervened between each of the successive mating periods and the temperature of the water at an earlier breeding site was always higher than that of a later at any given time. It is suggested that there may be a correlation between water temperature and the initiation of breeding activity in toads, the optimum in this case being about 24.5 C.

On the basis of the tagged specimens alone, it was found that toads did not travel from one breeding site to the other but when mating and egg laying were accomplished they left their own particular locality in the pond and did not return. With one exception, no marked toad was ever taken from more than one breeding site. This one exception was a female first found mating on April 20 along the north shore and again discovered mating and depositing eggs on May 7 at the third breeding site along the west shore. This is the only definite case of remating, for although six other individuals (three males and three females) were discovered mating the second time, these six were all retaken either the same day as originally tagged or else on the day immediately following. Mating pairs often became separated prematurely, which probably occurred in these instances. From these data it is indicated that toads will not ordinarily mate more than once and that they leave the breeding grounds very soon after mating. It is also shown, however, that toads may occasionally mate more than once.—JEAN PIATT, *Edmund Niles Huyck Preserve, Inc., Biological Research Division, Rensselaerville, New York.*

NOTES ON *SIREN INTERMEDIA*.[1]—The discovery of several *Siren intermedia* LeConte in underground burrows was reported to the author on December 29, 1939, by a W.P.A. crew excavating for a drainage ditch near Jackson Bridge, Little Muddy River, Franklin County, Illinois. On January 4, 1940, the author and Mr. Fred Cagle, of the Southern Illinois Normal University Museum, made the following observations.

The drainage ditch was being constructed in an ENE direction and was one-half mile from the Little Muddy River in the midst of a slough. Before draining, this slough was covered by 2 to 3 feet of water during the spring months when the river overflowed, but by mid-summer the slough was always dry.

The *Siren* were found 18 to 40 inches below the surface of the ground (this was the bottom of the drainage ditch). At the time of the investigation the ground was frozen to a depth of 6 inches and was covered by a 3-inch layer of snow. *Siren* removed from the ground were very active and tried to escape from the hands of their captors even though the air temperature was only a little above freezing.

The data as to the details of the burrows were meager, as the workers removed the dirt in 10-inch layers and the observers had no opportunity to follow one burrow continuously downward. The burrows appeared to have been constructed by crayfish. Several *Siren* escaped by going downward in these when disturbed. One *Siren* escaped at the 35-inch level, and a stick 3 feet in length was forced down the hole before the bottom of the burrow was encountered. Others were found at the ends of burrows where they were in a "J" position, the head being at the end of a short tunnel turning back vertically.

Of the 16 specimens collected in a two-week period, 12 were males and 4 were females. With but one exception their lengths and weights fit into the graph of length and weights given by Cagle and Smith (1939, COPEIA: 233). An estimated total of 60 to 70 *Siren* were found in the excavating work.

A similar discovery was reported in March, 1937, by a group of P.W.A. workers. They dug several dozen *Siren* from the bank of a stream near Marion, Williamson County, Illinois. They described the *Siren* as having been coiled in an oval space in the ground at a considerable distance from the stream. Another discovery was reported in 1940 by a W.P.A. gang excavating for a drainage ditch in the same county near Johnston City, where *Siren* were reported as found in underground cavities in a dry slough.

Carr's report of *Siren intermedia* in a crayfish burrow (Carr, Univ. Fla. Publ., Biol. Ser., 3: 51) and of *Siren lacertina* in spherical chambers underground after the water of their habitat had dried up seems to correlate with our observations of *Siren intermedia* in underground holes that appeared to have been crayfish burrows. This December-January discovery of *Siren* in an area dry since the preceding July and the earlier March record of *Siren* in an area dry since the preceding year indicates this species is able to endure seasons of drought by retiring underground, either by following crayfish burrows downward and enlarging them or by constructing their own burrows.—LENDELL COCKRUM, *Southern Illinois Normal University, Carbondale, Illinois.*

THE OCCURRENCE OF THE WOOD TURTLE IN IOWA.—On the basis of Palmer's report (1924, COPEIA, 128: 40) of an individual taken at Ames, the wood turtle, *Clemmys insculpta* (Le Conte), has been accredited to the Iowa herpetofauna by Pope (1939, Turtles of the United States and Canada: 94), Schmidt (1938, Ecology, 19: 406), and Stejneger and Barbour (1939, A checklist of North American amphibians and reptiles: 158). This specimen (bearing the data "wood turtle, *Clemmys insculpta* (Le Conte), Ames, Ia.; E. Laurence Palmer"; now number 25 in the Iowa State College collection) is a juvenile example of *Emys blandingii* (Holbrook), with the plastral hinge, highly arched and scarcely roughened carapace, and the pale immaculate throat characteristic of the species. Blanding's turtle is not rare in central Iowa, but in my three-year residence at Ames no evidence of the presence of the wood turtle in this vicinity has been secured.

An authentic basis for the inclusion of the wood turtle in the Iowa faunal list is now provided through receipt of 13 specimens (I.S.C. nos. 542–554) collected at Charles City, Floyd County, during the spring of 1941 by Mr. Omer C. Johnson of that city, who informs me that the species is common at this locality.—REEVE M. BAILEY, *Department of Zoology, Iowa State College, Ames, Iowa.*

[1] A contribution of the Museum of Natural and Social Sciences, Southern Illinois Normal University, Carbondale, Illinois.

A PLAGUE OF TOADS.—During the spring and early summer of 1941, while the eastern states suffered from a deficiency of rainfall, some of the states west of the Mississippi had an extraordinarily large supply. In Texas there was much rain, high water and some damaging floods. May, 1941, was the wettest month in the fifty-five year history of the Corpus Christi Weather Bureau station. Before the middle of June, 26 inches of rain had fallen, the equivalent of the average yearly supply.

Concomitant with the excessive rainfall there was an unparalleled abundance of toads in the Rockport area. In May the toads were obviously only recently transformed. On June 15 they measured from 20 to 30 mm. in length and were veritably ubiquitous. In some places the highways became greasy where they were crushed. They hopped along the roads, sidewalks, streets and fields, and I found them swimming in salt water where they hopped overboard from docks and wharves. At any time, except during the heat of the day, one might start at any given point and catch a toad within a few seconds. This condition extended at least as far east as the Guadalupe River, and probably prevailed over a large part of the south Texas coastal region.

All the specimens I have examined were Fowler's toad, *Bufo fowleri* Hinckley, but I have made no counts nor studied the problem in any way except in passing observations. That the majority of toads belong to that species seems to be a safe conclusion, but that they all do cannot be stated. These toads transformed from tadpoles about mid-May, which is about a month earlier than the beginning transformation date given for the species by Wright and Wright (1938, Trans. Texas Acad. Sci., 21: 18–20).

The study of this population of toads in various aspects presents an interesting biological problem, but the writer is able to do no more than record it in this brief form. This great abundance of toads is one of those extraordinary peaks of animal numbers, the importance of which has been pointed out in his several writings by the English zoologist, Elton. I have not searched the literature for like instances, and only one similar report comes to mind. It was stated (The Book of Exodus, Chap. 8, 6th verse), "And Aaron stretched out his hand over the waters of Egypt; and the frogs came up, and covered the land of Egypt."—GORDON GUNTER, *Game, Fish and Oyster Commission, Rockport, Texas.*

A DICEPHALIC QUEEN SNAKE.—A female queen snake, *Natrix septemvittata* (Say), collected at Athens, Clarke County, Georgia, gave birth to 13 young on September 7, 1939. Twelve of the offspring were normal, while one was a two-headed individual. This abnormal specimen, a male, measures 190 mm. in length, of which the tail comprises 60 mm. Its diameter is 10 mm., exactly twice the average diameter of the others of the litter, but it has the normal 19 rows of scales at mid-body. The two heads are incompletely separated, being fused in the parietal region. Most cases of such bifurcation extend to the neck vertebrae, resulting in two perfect heads. The lower jaws are somewhat malformed, being separated by a septum that appears to represent fused jaw elements from both heads. The specimen lived only a few hours, during which time it was quite active. —WILFRED T. NEILL, JR., *Augusta, Georgia.*

A CASE OF ALBINISM IN *DIADOPHIS P. PUNCTATUS.*—While collecting at Augusta, Georgia, on September 1, 1939, I found, beneath a pile of dead grass, an albino ring-necked snake, *Diadophis p. punctatus* (Linnaeus). The specimen was very young, measuring only 140 mm. in length. Dorsally it was pure white, with a pearly iridescence; and behind the head was a ring of pale lemon yellow. The ventral surface was light yellow, changing to a delicate rose pink on the under side of the tail. The eyes and tongue were dark red; and there was a dark red spot in the center of each ventral scute. When held to the light the specimen was quite translucent. As far as I have been able to determine, this is the only recorded instance of albinism in this species.—WILFRED T. NEILL, JR., *Augusta, Georgia.*

SOUNDS PRODUCED BY THE SLIMY SALAMANDER.—While collecting herpetological specimens in the Gambrill State Park, Frederick County, Maryland, on May 19, 1940, I collected a slimy salamander, *Plethodon glutinosus* (Green), under a flat rock. As I grabbed the specimen, it began to struggle violently and tried to twist itself free. It startled me by emitting several distinct squeaks; about ten of these sounds were

produced within a period of about two minutes. Mr. Harry C. Robertson has informed me that, during his many years of field work on reptiles in Maryland, he has heard this sound from the same species. Fifteen other specimens of *glutinosus* collected on the same day, and numerous others collected previously, never squeaked. Sounds produced by the lungless plethodont salamanders can scarcely be a true voice. Dunn (The salamanders of the family Plethodontidae, 1926) cites that Abbott (p. 277) recorded sounds from the common red salamander, *Pseudotriton ruber ruber* (Sonnini), and that Ritter and Miller (p. 214) noted that *Aneides lugubris lugubris* (Hallowell) "squeaked like a mouse."—ROMEO MANSUETI, *Natural History Society of Maryland, Baltimore, Maryland.*

NOTES ON NEW-BORN JUMPING VIPERS, *BOTHROPS NUMMIFERA*.—On March 16, 1940, a shipment of 112 reptiles collected in Honduras by Raymond F. Stadelman arrived at the Chicago Zoological Park. These included fifteen *Bothrops nummifera*, which varied in size from 9-inch juveniles to 28-inch adults, including two large gravid females. On July 17 twenty-one young were born, the last two dead before parturition, but fully developed, from a 22-inch female. Six were already born before parturition was noted at 8:00 A.M. The others were produced in rapid succession within 35 minutes. Each remained in the thin egg membrane for approximately 16 minutes before rupturing it. The first shedding of the epidermis occurred from 1 to 4 hours after birth. The average length of these specimens was 178 mm., diameter at mid-body 8 mm. The coloration ranged from brown with black saddles, to a yellow or grayish pink ground color with a copper-colored tail, as in young *Agkistrodon piscivorus*. The young snakes were very pugnacious, and the least annoyance would cause them to spring forward with mouth open.

The second brood of seventeen young was born on July 25 during the night, from a 28-inch specimen. It was noted throughout the next day that the female was laboring as if parturition was incomplete. Death occurred the following day, and upon posting the specimen six more young were found in the left oviduct. These averaged 203 mm. in length, diameter 10 mm.

According to previous records the number in broods of this species ranges from eight to fifteen (March, 1929, Bull. Antivenin Inst. Amer., 3: 28).—EMIL J. ROKOSKY, *Chicago Zoological Park, Brookfield, Illinois.*

THE WESTERN HOG-NOSED SNAKE IN ILLINOIS.—A single immature specimen of the western hog-nosed snake, *Heterodon nasicus* Kennicott (now referable to the northern subspecies, *H. n. nasicus*), was recorded by Garman (1892, Bull. Ill. State Lab. Nat. Hist., 3: 304), based on a specimen collected at Pekin, Tazewell Co., by S. A. Forbes, in 1874. There appears to be no further record of this species from the state until 1913, when Vestal (1913, *idem*, 10: 61) reported it from the sandy region near Havana, Mason Co., but without preserving a specimen.

In working over the collections of the Illinois State Natural History Survey in 1928–1929, this species seemed to offer a problem of especial interest. The late Carlos C. Goff obtained a specimen in October, 1929, near Amboy, Lee Co., in an open sandy oak woods, which was forwarded to me. In June, 1931, while searching for egg-laying turtles at Meredosia, Morgan Co., Drs. J. D. Combs and D. H. Thompson found an adult female *nasicus* engaged in extracting turtle eggs from a covered nest in the sand. In 1935, while I was collecting reptiles for the State Survey in southern Illinois, Mr. C. J. Firkins reported a specimen from the highway about 5 miles south of Havana, and this specimen was subsequently obtained as a loan.

All four of these specimens come from sandy areas, and may well represent a relict population as suggested by Schmidt (1938, Ecology, 19: 405). All are typical *nasicus*. It may be mentioned that during four years at Minot, North Dakota, where this species was common, I found it by no means confined to sandy areas, and observed it digging effectively in sod.—WILLARD F. STANLEY, *State Normal School, Fredonia, New York.*

FALL MATING AND COURTSHIP OF THE MUSK TURTLE.—Risley (1933, Mich. Acad. Sci., Arts and Letters, 17: 708) states that the musk turtle, *Sternotherus odoratus* (Latreille), mates in the spring in southern Michigan between the approximate dates of April 1 and May 15, and that mating may also occur in the fall. Evermann and Clark (1920, Lake Maxinkuckee, etc.) record having observed copulating pairs of this species in Lake Maxinkuckee, Indiana, on November 1, 1904, and on September 13, 1906. I have obtained further records of fall mating in Michigan as well as some data on behavior during courtship in captivity. On September 23, 1937, at 8:30 A.M., I found two musk turtles in copulation in 4 inches of water under a beached boat at Whitmore Lake, Washtenaw County. The lake bottom beneath the boat was sand and gravel. I did not know that the specimens were actually in coitu until I picked them up and the male was then seen to withdraw his penis from the cloacal aperture of the female. On October 30, of the same year, several musk turtles were seen moving about on the bottom of this lake, frequently in couples that proved on examination to be pairs. These pairs were usually seen in from 1 to 2 feet of water, but none were observed in copulation.

On two occasions in the fall of 1938, mating pairs were found in conventional turtle traps that I had set. The first of these was in Sherman Lake, Kalamazoo County, at 8:00 A.M., on September 17. The second was in Wolf Lake, Van Buren County, on September 20 shortly after 8:00 A.M.

A pair of musk turtles in copulation was taken from a fish rearing pond at Drayton Plains, Oakland County, on October 27, 1938, by W. F. Carbine. In captivity, the male made repeated but unsuccessful attempts to copulate. In these attempts two distinct positions of the male were noted. In one, the male mounted the female from behind. He grasped the lower edge of her carapace rather well back on the body with all four feet. Additional support for his body in this position was gained by complete extension of his head and neck, with firm apposition of the chin and throat of the male to the anterior, down-curving part of the carapace of the female.

In the second position the male was observed to approach the female at right angles. Passing behind her body he would entwine her tail between his left leg and his tail. At one time this pose was retained for four minutes, but copulation was not attempted. This position may be one of the positions normally employed in mating, and it would seem particularly useful for approaches made by smaller males to larger females.

Continued but unsuccessful attempts at mating were observed during the last days of October and the first days of November. The turtles were kept in the aquarium in the laboratory at room temperature and accepted small amounts of food all winter. During the last week of March the male again made several attempts to mount the female; none of those seen was successful.—KARL F. LAGLER, *Department of Zoology, University of Michigan, Ann Arbor, Michigan.*

AN ADDITION TO THE HERPETOFAUNA OF WEST VIRGINIA.—On April 20, 1940, a specimen of *Leiolopisma unicolor* (Harlan) was collected in Hardy County, along the South Branch of the Potomac River, seven miles southeast of Moorefield. The skink was found under a large limestone rock in a pasture field at an elevation of 1100 feet. The field, about 3 acres, is covered with short grass, few trees, and well supplied with water. The specimen was examined and the identification confirmed by Dr. C. M. Bogert, but was later presented to Carnegie Museum.

A second specimen was collected June 2, 1941, 5 miles south of Moorefield, in a chrysanthemum bed. The elevation at this locality is about 1000 feet. Although the two locations are separated by Elkhorn Mountain the habitat in both instances was practically the same in elevation, low cover, and well watered soil. This specimen is No. 52 in my own collection. These are apparently the first two records of this species for West Virginia.—L. WAYNE WILSON, *Moorefield, West Virginia.*

BIRTH OF TWO BROODS OF MASSASAUGAS.—Three adult specimens of the massasauga, *Sistrurus catenatus catenatus* Rafinesque, two of them gravid females, were collected by the writer at Wooddale, Du Page Co., Illinois, June 26, 1940. Local residents of this village had reported rattlesnakes to Field Museum in the spring of 1940. This locality appears to represent a new station for the species in the Chicago area. Wooddale is adjacent to a section of marsh and woodland.

The two females were kept at the Museum in the expectation of their producing young. One of them (FMNH 35309) gave birth to eleven young during the night of August 19, only seven of which were alive the following morning.

The second female (FMNH 35314) produced a brood also numbering eleven on the morning of August 30. The fourth birth began at 10:00 A.M. The time required for parturition and the intervals between the successive births are shown below.

Birth No.	Time to complete birth min	sec.	Birth Nos.	Interval between births min.	sec.
4	7				
5	8	20	4 & 5	0	10
6	6	10	5 & 6	immediately	
7	4	20	6 & 7	0	50
8	5	35	7 & 8	3	25
9	1	35	8 & 9	4	5
10	4	45	9 & 10	22	
11	3	40	10 & 11	33	20

After expulsion from the mother's body (which is here regarded as birth), the young snake remained enclosed in the foetal membrane for as long as nine minutes. There is a feeble but distinct "rattling" vibration immediately after emergence from the membrane when the young snake is annoyed. Shedding of the skin in the seven specimens of the first brood took place from 10 to 15 days after birth. In the second brood the skin had been shed by all within 8 days.

The dimensions (in mm.) and the scale counts of parents and broods, are given in the following table:

Sex	Number of Specimens	Ventrals Extremes	Ventrals Mean	Caudals Extremes	Caudals Mean	Av. Length Body	Av. Length Tail
		No. 35309 and Brood					
♂	7	140–143	142	22–28	25.7	180.7	23.5
♀	4	147–148	147.2	21–23	22	180.7	19
♀	Parent		146		22	551	67
		No. 35314 and Brood					
♂	7	138–141	139.9	23–31	27	169.4	21.8
♀	4	144–148	146	19–29	23	175	17.5
♀	Parent		148		21	579.2	50.8

The total lengths (in mm.) of the specimens that died at birth are, for the males, 158.5, 167.5, 168.0, 169.0, and 185.5; for the females, 167.0 and 180.0. Some of these lengths equal those of the young that lived over a week longer.

The position of the umbilical scar, reckoned by the number of ventrals between its approximate center and the anal plate, varies from 13 to 18. The difference in this character in the sexes is shown below:

VENTRALS FROM CENTER OF UMBILICAL SCAR TO ANAL PLATE

Sex	No. Spec.	Extremes	Mean
♂	14	13–18	14.2
♀	8	15–18	16.3

I am indebted to Mr. Clifford H. Pope, Assistant Curator of Reptiles at Field Museum, for aid in drawing up the present note.—EDWARD C. TOBIASZ, *Field Museum of Natural History, Chicago, Illinois.*

Ichthyological Notes

A NOTE ON THE SPAWNING OF THE BLACK COD (*ANAPLOPOMA FIMBRIA*).—*Anaplopoma fimbria*, the "black cod" or skil-fish, is a fish similar in general appearance, habits and habitat to the cod, though it is a Percomorph fish, one of the Hexagrammidae. It is of rapidly increasing importance as a secondary product of the Pacific coast halibut fishery along with two related fishes, the "ling cod" *Ophiodon elongatus* and the "red cod" or red snapper *Sebastodes ruberrimus*. The "black cod" fishery is of special importance during the winter closed season for halibut. During that season gear is set on grounds below 100 fathoms, where *Anaplopoma* is the dominant species. Rising prices quoted for these fish during the past winter almost certainly will bring about a great intensification of the fishery in coming years. Studies on the life history of this fish, commencing now, will be of great value in future regulation designed to hold the fishery at the optimum level.

On March 4, 1941, the halibut schooner "Eagle," under charter by the International Fisheries Commission to make plankton tows off Cape St. James, took several specimens of *Anaplopoma* on halibut gear set to obtain "cook fish." The set was made a few miles off Cape St. James at 51° 45′ N. and 130° 47′ W. in 137 fathoms. I was working on the "Eagle" as a member of the scientific staff and found, among the *Anaplopoma* taken, a female with ripe eggs running. The fish was flabby and very nearly spawned out but I was able to obtain and water harden a number of eggs. I preserved them in 4 per cent formaldehyde, as is the practice of the International Fisheries Commission in preserving the plankton hauls made by its expeditions.

The eggs are free floating ova of the pelagic type. The mean diameter of 184 eggs is 2.056 mm. and the standard deviation is .0414 mm. The outer membranes of the eggs are very smooth, though examination under high power and reflected light often brings out some very fine straight lines on the surface, occasionally in such numbers that they form a sort of network. The distribution of these lines, however, is rather disorderly and I think they were probably caused by handling the eggs. No oil globule is present. The vitelline space is fairly narrow.

In the examination of samples of eggs from eight plankton hauls made by the Commission between December 11, 1936, and February 2, 1937, during the spawning season of the halibut, only one egg close to the size of the *Anaplopoma* egg was found, out of 483 measured. It occurred in the last of the group of hauls, February 2, 1937, and was 2.15 mm. in diameter.

Haul No. 1935 A taken January 13, 1941, at 52° 00′ N. and 131° 14′ W., produced one egg 2.13 mm. in diameter, out of 92 examined.

Haul No. 2059 B made March 3, 1941, in 600 fathom water at 52° 7′ N. and 131° 26′ W., showed a group of 78 eggs similar in appearance to the eggs taken from *Anaplopoma* the next day, except that the outer membranes were even smoother, presumably because they had been handled less than the water-hardened eggs. Several of these eggs contained embryos half the circumference of the outer membrane in length. In none of the embryos had any pigment or distinctive characters developed. The mean diameter of this group of eggs is 2.097 mm. and the standard deviation is .0553 mm. This haul was made with a one meter net which was dragged for 20 minute periods on 600, 500 and 400 meters of cable after the practice of the Commission.

The measurements of the 1941 eggs were made to 1/222 mm. with an ocular micrometer calibrated from a stage micrometer. Two measurements at right angles were taken on each egg.

If the eggs taken in haul 2059 B are all "black cod" eggs, as seems very probable, the mean of 2.097 mm. found for them is probably a better mean for the species than the 2.056 mm. found for the water hardened eggs, which were taken from a single individual. The spawning season of this species off Cape St. James seems to follow that of the halibut, probably starting in February when the abundance of halibut eggs is beginning to fall off.—WILL F. THOMPSON, JR., *State of Washington, Department of Fisheries, University of Washington, Seattle, Washington.*

THE OCCURRENCE OF THE FISH, *ASIPHONICHTHYS STENOPTERUS* COPE (CHARACIDAE), NEAR MONTEVIDEO.[1]—Recently Juan Martinez sent to the U. S. National Museum a specimen of *Asiphonichthys stenopterus* Cope (Amer. Nat., 1894: 67; Proc. Amer. Philos. Soc., 33, 1894: 85, pl. 5, fig. 2) for identification. It was collected from the Montevideo swamps of "Carrasco."

This species is of interest since it has been reported from Uruguay as *Charax gibbosus* (Linnaeus) by Garibaldi J. Devincenzi and Diego Legrand in their *Album Ictiologico del Uruguay*, pl. 49, bottom figure (Anales Mus. Hist. Nat. Montevideo, 1940). It is likely that Devincenzi, in his No. 13, *Peces del Uruguay* (Anales Mus. Hist. Nat. Montevideo, 4, 1939: 14) has confused *Charax gibbosus* (Linn.) with *Asiphonichthys stenopterus* Cope since his fig. 2, pl. 49 (*l. c.*) is an excellent figure of the latter species.

The specimen of *A. stenopterus* before me has 47 scale rows crossing the side of the body and only 8 or 9 pores in the lateral line just behind the shoulder; 20 or 21 scales in a transverse series from origin of first dorsal; dorsal rays 10; anal with first 4 simple followed by 42 branched rays totaling 46; pelvics 9; pectoral 15; gill rakers 7+10, and elongate-narrow. The color consists of a blackish blotch just behind upper part of operculum on the shoulder and a narrow, somewhat broken, blackish lateral band ending in a dark caudal blotch. The operculum, tip of lower jaw, upper surface of head and around the orbit with blackish pigment.

The chief difference between *Charax* and *Asiphonichthys* is the incomplete lateral line in the latter genus. There are no horny spines on the tip of the snout in either genus as in *Roeboides*.—LEONARD P. SCHULTZ, *U. S. National Museum, Washington, D. C.*

MORTALITY AT FISH HATCHERY CAUSED BY LIGHTNING.—Lightning struck the same pond twice at the New York Conservation Department fish hatchery near East Randolph, Cattaraugus County, New York, and a large mortality resulted among brown trout, *Salmo trutta* Linnaeus. Mr. G. C. Phillips, superintendent of the hatchery, observed the lightning strike and supplied most of the details reported below. The injured fish were observed by the writer five days after the last shock.

Lightning first struck on the afternoon of June 28, 1941. The troughs were located in an exposed area where no trees or telephone poles were present. They were arranged in 6 rows with 4 troughs to a row. Each was built of cement and measured 45 by 10 feet. One of the troughs in an outside row was struck. About 200 large female breeders from 15 to 20 inches in total length and from 1.5 to 2.5 pounds were found dead. Many were killed at once, but numerous others were paralyzed and succumbed in a short time. Another bolt hit the same trough on the evening of July 30, 1941, and killed or paralyzed approximately 50 additional trout. In neither instance were all the fish killed. However, the mortality was serious since the fish were selected female breeders. Another mortality due to lightning occurred at the same hatchery five years ago. Several other New York hatcheries have reported similar occurrences during the past ten years.

Pronounced dark bands of varying width crossed the back and reached to, or nearly to, the abdomen of the dead and paralyzed trout. The locomotor activity of many of the remaining trout was affected to some extent. Most remained lying quietly on their side on the bottom of the pond. When disturbed by touch they would swim slowly about but they had difficulty in moving the posterior part of the body. Some swam feebly in a vertical position with the head downward and others progressed upside down for several minutes. They finally fell to the bottom of the tank and remained there for long periods with only the paired fins moving occasionally. These paralyzed fish finally died of starvation although a few lasted for approximately one month. An internal examination of those which were killed immediately by the lightning revealed internal hemorrhages, and the heart, liver, and ovaries were often ruptured. The air bladder was not broken. Numbers of those which died after a few days had the ovaries broken and numerous eggs were embedded in the liver.

It appears plausible that some fish kills in lakes may be due to lightning since the latter has been observed to strike large bodies of water. However, it seems unlikely that such a phenomenon would account for any mortality in streams except perhaps in exposed areas where no trees are present.—EDWARD C. RANEY, *Department of Zoology, Cornell University, Ithaca, New York.*

[1] Published with the permission of the Secretary of the Smithsonian Institution.

RANGE EXTENSIONS AND REMARKS ON THE DISTRIBUTION OF *PAREXOGLOSSUM LAURAE* HUBBS.—*Parexoglossum laurae* was originally described from specimens taken in West Virginia and Virginia in the upper Kanawha drainage system above the great falls of the Kanawha River in West Virginia (Occ. Papers Mus. Zool., Univ. Mich., 234, 1931). Recently it has also been found in the upper Allegheny River system in Pennsylvania (*ibid.*, 396: 1) and New York (Suppl. 27th Ann. Rept. N. Y. Cons. Dept., 1937 [1938]: 68). During the past year (1940) specimens have been taken in the Genesee River in New York and in the New River, North Carolina. This adds another species to those fishes known to occur in the Great Lakes drainage (Lake Ontario). It is also an addition to the known freshwater fish fauna of North Carolina.

In North Carolina one adult and three yearlings were seined in the North Fork of the New River near Creston, Ashe County, on April 1, 1940. The specimens were taken while seining at night in a moderately swift riffle 75 feet wide and of an average depth of one foot. No other *Parexoglossum* were taken at two other stations on the same stream and none were collected at any of the six stations seined on the South Fork of the New River.

The specimens from the Genesee River were collected in the upper reaches of this stream, above Wellsville, Allegany County, New York, from August 12 to 16, 1940. They were taken largely from the smaller of two channels at a point where the stream divided in an area of shallow pools and riffles. Several additional specimens were collected in the slower moving and deeper waters of the main stream but in general it appears to prefer the smaller channels. Observations over several years on living specimens indicate it to be a somewhat sluggish bottom hugging form as is its eastern relative *Exoglossum maxillingua*.

Exoglossum was reported from the Genesee as "moderately common in warm streams" by Greeley (Suppl. 16th Ann. Rept. N. Y. Cons. Dept., 1926 [1927]: 60) before *Parexoglossum* was described. Dr. John R. Greeley has recently examined the extant specimens of both *Parexoglossum* and *Exoglossum* which were taken in the Genesee Drainage by the New York Biological Survey and which are now stored in the New York State Museum, Albany, New York. He found *Parexoglossum* only in the upper Genesee River system above the impassable falls at Portageville, New York. *Exoglossum* was taken in lowland tributaries of the Genesee River along the Lake Ontario plain. During the summer of 1939 Greeley (Supp. 29th Ann. Rept. N. Y. Cons. Dept., 1939 [1940]: 75) found *Exoglossum* ranging as far west in Lake Ontario tributaries as Salmon Creek in Monroe County, which is west of the mouth of the Genesee River.

The presence of *Parexoglossum laurae* in the upper Genesee River presents an interesting problem in distribution. The species occurs in the adjacent upper Allegheny River system in western Pennsylvania and it appears most likely to have reached the Genesee from the Allegheny system by utilizing postglacial outlets. During recent times *Exoglossum* has been prevented from reaching the upper waters of the Genesee River by the high falls at Portageville. On the other hand *Parexoglossum* was apparently not able to get established or survive below the falls. This situation is paralleled in part, by the distribution of *Parexoglossum* in the Kanawha River system. It is found above the great falls of the Kanawha River in West Virginia, Virginia and North Carolina but has never been taken below this falls.—EDWARD C. RANEY, *Department of Zoology, Cornell University, Ithaca, New York.*

NOTES ON *TRINECTES MACULATUS* (BLOCH AND SCHNEIDER).—On June 12, a sole identified as noted above by Dr. L. P. Schultz of the U. S. National Museum, was brought to me by a friend who stated that he had caught it in the Eastern Branch of the Potomac River with a dip net. I placed this fish in a 4½ foot terra-cotta bowl in my garden where it seemed to flourish. However, after a heavy freeze on December 1, I found it dead and turned it over to the U. S. National Museum. I am told that this is a rather long record for this fish in captivity; hence this note.—PAUL BARTSCH, *U. S. National Museum, Washington, D. C.*

Reviews and Comments

LIVING TREASURE. By Ivan T. Sanderson. Viking Press, New York, N.Y., 1941: 1-290, 32 sepia illus.—The phenomenon of a popular literary vogue of a naturalist is by no means new. In our own generation, that of William Beebe's long series of books is most familiar, and Ivan T. Sanderson's fourth volume appears to establish him in the category of naturalists who have gained this distinctive kind of success. In view of the wide disagreement over the scientific merits of Mr. Beebe's books and essays among his more technical colleagues, it is not especially surprising to find views equally divergent about Mr. Sanderson's books. Reports from those who have had personal contact with Mr. Sanderson in the field speak favorably of him, of the effectiveness of his work, and of the genuineness of his interest. The collections on which much of *Living Treasure* is based are stored in Field Museum, to avoid the 1941 hazards of shipment to England, and the amphibians and reptiles, in particular, have been identified for Mr. Sanderson by the reviewer.

Mr. Sanderson's books, the current one as well as its forerunners, vividly reflect a somewhat extraordinarily excitable temperament. This artistic temperament no doubt accounts for some hasty generalizations and misinterpretations of observations, and for the aversion with which these books are regarded by those of Mr. Sanderson's colleagues who do not share or understand his temperament. The merit discernible in the excitement of Mr. Sanderson when faced by an animal new to his experience is his enthusiasm, which, as may been seen from the reviews of his books by non-biologists, is transmitted effectively to his readers.

Mr. Sanderson's transposition of the generic name *Corythophanes* into *Coryopthanes* is unfortunately conspicuous on account of its appearance on the remarkably fine drawings of the two distinct species secured by him, and the importance of these creatures in his discussion of ecological niches. The illustrations, in Mr. Sanderson's distinctive pencil technique, present portraits of a variety of Central American mammals, of a few invertebrates, and of ten amphibians and reptiles. The latter include the second appearance in the literature of the reviewer's small salamander, *Oedipus elongatus;* two frogs, *Hyla baudinii* and *Rhinophrynus dorsalis*; the Belize crocodile, *Crocodylus moreletii*; a turtle, *Kinosternon creaseri;* three lizards, *Anolis sagrei* and *Corythophanes cristatus* and *fernandezi;* and two snakes, *Trimeresurus nummifer* and *Sibynophis annulata.*—Karl P. Schmidt, *Field Museum of Natural History, Chicago, Illinois.*

A HANDBOOK OF SALT-WATER FISHING. By O. H. P. Rodman. Frederick A. Stokes Company, New York, 1940: i–xi, 1–269, several figs. $1.75.—This is a miscellaneous assortment of information on the selection and use of angling gear and on the technique of its operation. In addition, a number of species of the Atlantic and the Pacific marine game fishes are described and figured, and for these there are notes on distribution, habits, fishing season, methods of fishing, etc. About 42 fishes are included in this section of the book; these represent, of course, only a fraction of what an angler would find on our coasts. The drawings, for the most part, are wretched, having neither accuracy nor charm, and are of doubtful help for identification. A few have been copied from other books, with at least one curious result: Jordan and Evermann's figure of the Atlantic barracuda, *Sphyraena barracuda,* has been used to illustrate the California barracuda—*S. argentea.* The book is contained in a transparent oilcloth envelope, so that one may carry it in the field without getting it wet—an excellent innovation.—L. A. Walford, *Jordan Hall, Stanford University, California.*

CLASSIFICATION OF FISHES, BOTH RECENT AND FOSSIL. By Leo S. Berg. Travaux de l'Institut Zoologique de L'Académie des Sciences de l'U.R.S.S., 5, part 2: 87–517, 190 figs. Royal 8vo., bound in waterproof cloth, with complete English and Russian texts. Akademiia Nauk, Leningrad, 1940.—To have the most complete and modern text on fish classification appear, in English, in a Russian publication, will surprise all except those who have been aware of Dr. Berg's long labors on this volume. Except for a few of the introductory remarks, the Russian text (pp. 87–345) appears to be translated completely into English (pp. 346–500). The numerous well-reproduced figures are entirely in the Russian section, but they bear double legends, and are referred to by number and page in the English part, so that no difficulty is experienced in their use. And not least, the execrable paper and printing which we have been led to expect in nearly all Russian scientific papers are conspicuous by their absence. The printing is clear and done on relatively good white sulphite paper.

The book aims to give a complete arrangement of all the families of living and fossil fishes known at the time the manuscript went to press (May, 1937) and contains numerous additions made while in press. Concise anatomical definitions are given of all or nearly all groups above family rank, and of the relatively large number of families on which the author has new facts or interpretations to offer. Subfamilies are mentioned but rarely and genera only in discussions or in families based upon single genera. Many synonymic names of the higher groups are listed and there is a brief statement of the geographical and geological range of each group recognized. Perhaps most useful of all are the references. Practically every page bears footnotes citing three to a dozen or more of the most important and recent papers dealing with the morphology and classification of the groups considered on that page—a mighty compendium of scattered literature that will delight the heart of every serious user. Most of the illustrations are taken from this literature, and the author has chosen well.

To evaluate a work of such wide scope is difficult, and estimates will vary according to the groups with which the prospective user happens to be familiar. We may say at once that Dr. Berg's work takes pre-eminence over all past efforts of the kind if only because of its breadth and completeness, and of the obviously wide knowledge and insight that went into its production. But there is more to it than that. Anyone familiar with Dr. Berg's monumental "Fresh-water Fishes of the U.S.S.R." (now in its third edition) and his exceedingly numerous other papers is aware of his extensive and penetrating knowledge of recent fishes, and this knowledge is again apparent in the present work. Moreover, he has contributed original papers on fossil fishes and in his "Classification" he has done ichthyologists a really great service in sifting and collating the extensive, important and exceedingly scattered recent literature of palaeichthyology. Naturally it can be said that most of the text on fossil (and much of that on recent) fishes is a compilation, but it should be remembered that there is no living man really familiar at first hand with both of these fields, and few that would be competent to handle either one of them on a world-wide scale. Moreover, the rarity of much of the important known material of fossil fishes effectively precludes any but a perennial globe-trotter seeing much of it first hand.

In the major divisions Dr. Berg's system agrees very well with the classifications of the most recent workers in Europe and America. He does not, however, accept the division of the lower Gnathostomes into the classes Aphetohyoidea, Chondrichthyes, and Osteichthyes, as do Watson, Moy-Thomas, Forster-Cooper and others, nor does he attempt division of the Osteichthyes into Actinopterygii and Amphiboidei (or Choanichthyes), though I rather imagine that he would have accepted some of these later refinements if they had not been proposed just as his book went to press. Numerous new families are proposed, mostly for segregates of fossil families. Some may feel that Dr. Berg has gone too far in this, but the reviewer feels that most of the splitting has been carried on circumspectly, in the fully justifiable belief that the present active work on fossil fishes will soon show many now isolated fossil genera to have been but representatives of formerly large and flourishing groups.

In ordinal names Dr. Berg adopts the uniform ending—*formes* to the generic root of the typical family name, thus following Goodrich in fishes and Wetmore and Miller in birds, although the reviewer opposes this sweeping away of nearly all our familiar ordinal terms. Also, Dr. Berg forcefully dissents from strict application of priority in

generic and specific names, apparently without real knowledge of the International Rules or the Opinions of the International Commission on Zoological Nomenclature, and he still sticks to his own peculiar *-ini* ending for subfamily names. But he has straightened out some tangles in the generic names of fossil fishes, which should do our nomenclaturally anti-social palaeichthyologists some good.

In concluding this review of an exceedingly important book, the reviewer wonders if any but the few copies now in this country will ever be available. His copy from the author arrived during the siege of Leningrad, in September, 1941, and it may be that Dr. Berg, the Zoological Museum of the Academy of Sciences, and the stock of this book have all perished in the maniacal bombardment and bombing of that city.—GEORGE S. MYERS, *Stanford University, California.*

GUIDE TO THE FISHES OF THE GREAT LAKES AND TRIBUTARY WATERS. By Carl L. Hubbs and Karl F. Lagler. Cranbrook Institute of Science, Bloomfield Hills, Mich., Bulletin no. 18, 100 pp., 33 text-figs., 16 plates, 1941. Cloth, $1.00; paper, 50c.—This manual, which replaces Hubbs' 1926 Great Lakes checklist and Hubbs and Lagler's key of 1939, aims almost solely at the correct identification of the species of the Great Lakes drainage basin, and for a work of this type it is the best thing the reviewer has seen. Everything that a fish identification manual should have is present—an explanation of the area and drainages covered, a good drainage map, figures showing the anatomical characters used and a description of methods of counting and measuring, carefully worked-out and usable *illustrated* keys, accurate and really dependable statements of ranges and habitats, an excellent bibliography of the literature on the fishes of the area and surrounding regions (including general revisional studies), and a series of beautiful plates illustrating a large number of the species and their sexual differences. Above all, it has one thing the lack of which causes most identification manuals to fail—the assurance of a thorough first-hand knowledge of the fauna and of the local *and general* literature on the part of the authors.

The plates, which add so greatly to the value of the work, are mostly from photographs by the late Dr. F. N. Blanchard, and we are indeed glad that these could be published. They fit in well with the beautiful typography, good paper and pleasing binding of the volume. Only a few of the too finely stippled line-cuts and the poor halftone reproduction of figures 2 and 3 detract from the appearance of a fine piece of bookmaking.

Faults can be found with any book, but when one considers that the present work is obviously intended solely for specimen identification in a region where such a manual is in demand and will have wide use, the reviewer finds his minor objections fading. He does, however, admit a purely personal dislike of manuals lacking descriptions and life history notes. Moreover, he objects strongly to the publication of new systematic conclusions (e.g., the resurrection of *Lepisosteus productus*) in a manual of this type, and is tantalized to distraction by the bare suggestions of new and unpublished systematic conclusions on non-Great Lakes fishes which Hubbs and Lagler's nomenclature and range statements frequently give us.—GEORGE S. MYERS, *Stanford University, California.*

A TEXT-BOOK OF ZOOLOGY. By T. Jeffery Parker and William A. Haswell. Sixth edition. Vol. 1 (Protozoa to Chordata), revised by Otto Lowenstein, xxxii—770 pp., 733 figs. Vol. 2 (Chordata), revised by C. Forster-Cooper, xxiii—758 pp., 656 figs. Macmillan and Co., Ltd., London, 1940. $16 ($9 per volume).—More than one graying devotee of the great discipline of Huxley, Gegenbaur, Kovalevsky and Quatrefages has lately been heard to remark that a few years more will see the end of anyone who really knows morphological zoology thoroughly. In America this is certainly true. Function has very nearly crowded Form from the university curriculum, and we see everywhere "Departments of Biology," staffed by men who are essentially physiologists and who frequently know little more morphology, ecology, and classification than they are forced to give in lectures to elementary students. American text-books reflect this change; it is fast becoming the rule rather than the exception to find elementary zoology (or biology) texts marred by morphological ignorance so naive or egregious as to make the zoologist of the 90's either ill or apoplectic, depending on the predilection of his choler.

In the forty years during which this change has been taking place, "Parker and Haswell" has been the standard text to which each generation of American zoology students has been referred for its elementary morphological training, and to this text more than to any other may we give credit for whatever modicum of morphological leaven the protoplasmic dough of American biology may possess. Yet we have all realized that the successive editions of this work, each a little—but very little—changed from the first one of 1898, have grown pretty tarnished, and we are sometimes led to wonder whether a few of our growing crop of experimental brethren have not been led to their faintly supercilious opinion of morphology, at least partly, by the somewhat mildewed Victorian complacency of our most durable text.

The new Parker and Haswell has been thoroughly renovated. Gone are the small cramped pages, the fuzzy type, and the cuts grown dull from too much use. The page size is larger, many new illustrations march alongside old familiar ones now reproduced from new cuts, and the entire text has been reset in good, clear type.

The textual revision has been extensive, although the revisers have happily not attempted to alter the former general limits and purpose. The treatment of the invertebrate phyla has been radically altered, and if some parts of the system followed do not yet agree with the views of many specialists, at least it is a relief from the archaic arrangement of former editions. But we can see no valid reason for the continued refusal to grant phylum rank to groups like the Chaetognatha, Nematoda, and Ctenophora, which the reviser admits are totally isolated from other phyla.

The second volume provides us with the first reasonably up-to-date classification of fishes that has appeared in any general zoology text-book published in English for many years. This remarkable achievement seems to have stemmed from the fortunate selection of Dr. C. Forster-Cooper of the British Museum as reviser, and the aid given him by the staff of that institution and by a group of British zoologists which includes a number of the men most active in fish morphology and paleontology. Some 268 pages are concerned with those groups generally dealt with by ichthyologists (*Amphioxus* through teleosts and lungfishes) and large parts of this section, especially those on the later sensational developments in paleichthyology and on teleost classification are newly written.

The herpetologist will be less pleased with the book than the ichthyologist, and we may ascribe this to the unaccountable absence of Mr. H. W. Parker of the British Museum from the list of consultants. Of course the modern Amphibia do not bulk large in the zoological picture, but they are important laboratory animals everywhere, and the very weak treatment their classification receives is not to be excused on the basis of a single footnote referring to Noble's "Biology of the Amphibia" for further details. Treatment of the recent reptiles is little better.

Some may note the continued lack of evolutionary correlation between different groups and organs treated in different parts of the book, and we believe that some attention to this matter could have improved the book immensely without great increase in bulk. But to have given evolutionary history the place and importance it really deserves would have necessitated a total revision of the style and method of treatment of Parker and Haswell and the production of a wholly new book. Such evolutionary histories of organs and animals are already available in good comparative anatomy and vertebrate paleontology texts, and we believe that the old place taken by Parker and Haswell should not be left vacant.

A few things in the work are disappointing. The elaborate (chordate) index is almost comically annoying in the manner in which it frequently shunts one about (sometimes through as many as five synonymous terms) before one finally reaches a name to which the page-reference is appended. In volume one running heads referring to the phyla are adequate, but in the second volume the utilization of "Phylum Chordata" throughout is consistency carried to uselessness. And in the revision of the two volumes by different men, the intention of the original authors to have a section of references to important general and invertebrate literature at the end has been lost sight of, and none is given. But these are minor matters, and we believe that the revised Parker and Haswell will long continue to be the zoological mainstay in a world of protein molecules and bioelectric potentials.—GEORGE S. MYERS, *Natural History Museum, Stanford University, California.*

THE PLAGIOSTOME HYPOPHYSIS, GENERAL MORPHOLOGY AND TYPES OF STRUCTURE. By Harry Waldo Norris. 91 pp., 103 figs., cloth-bound. Published by the author, Grinnell College, Grinnell, Iowa, 1941.—This is a straightforward morphological account of the *hypophysis cerebri* of sharks and rays, based upon an investigation of 51 genera. The author finds two main types of hypophysis in these fishes, a selachoid type and a batoid type, corresponding with the Pleurotremata and Hypotremata, but distinguishes strong pleurotrematid tendencies in the hypophysis of the pristids, rhinobatids, narcobatids, rajids and discobatids. There is a bibliography and an index.—GEORGE S. MYERS, *Stanford University, California.*

FISHING THE SURF. By Raymond R. Camp. Little, Brown and Company, Boston, 1941: i–x, 1–219, figs., $2.00.—This factual book on surf fishing is distinguished for being less sentimental and more full of useful information than are most books on this subject. There are practical and intelligible instructions for selecting and using gear; and a few chapters on individual species, for which special fishing techniques are described.—L. A. WALFORD, *Jordan Hall, Stanford University, California.*

EDITORIAL NOTES AND NEWS

Smith Memorial Number

AT THE 1940 September meeting of the board of governors of the society, it was voted (COPEIA 3, 1940: 212) to prepare an appropriate anniversary number of COPEIA honoring DR. HUGH M. SMITH. Dr. Leonard P. Schultz was given the responsibility of assembling the material for this issue which was planned for Dr. Smith's 76th birthday, November 21, 1941. The various articles were in the hands of the editors by the middle of July and the galley proofs were corrected early in September. Then suddenly on the morning of September 28th, at 5:45 A.M., Dr. Smith died of a heart attack after but a few hours of illness. While this number was in page proof it was necessary to change it to a memorial number. The publication was to be a surprise to him. However, it is of some satisfaction to those who worked on this material to know that Dr. Smith knew that some tribute was being prepared for his 76th birthday.

The editors wish to acknowledge here their deep appreciation of the able assistance of DR. LEONARD SCHULTZ in the preparation of this issue. Dr. Schultz not only assumed the responsibility of assembling the funds and the special articles but also aided materially in the editorial work.

The publication of the Smith Memorial number of COPEIA was made possible by the generous financial assistance rendered by the following: W. R. Allen, Sarah R. Atsatt, Edwin G. Baetjer, John W. Bailey, Reeve M. Bailey, Thomas Barbour, Paul S. Bartsch, Sherman C. Bishop, Ward T. Bower, C. M. Breder, Jr., John Breukelman, Charles M. B. Cadwalader, Austin H. Clark, Hubert Lyman Clark, H. Walton Clark, Nellie L. Condon, Lee S. Crandall, L. R. Donaldson, R. H. Fiedler, Stanley Field, A. K. Fisher, W. I. Follett, Childs Frick, H. T. Gaige, John E. Graf, E. W. Gudger, Wm. T. Innes, W. J. Hamilton, E. S. Hathaway, E. Rolland Herriman, S. F. Hildebrand, Isabel Hoopes, Carl L. Hubbs, H. A. Kelly, L. M. Klauber, Ernest A. Lachner, Michael and Helen Lerner, James E. Lynch, Daniel Merriman, Wm. B. Mershon, R. R. Miller, H. F. Moore, Stanley Mulaik, Paul R. Needham, M. Graham Netting, J. T. Nichols, Daniel C. O'Neil, Raymond C. Osburn, G. H. Parker, C. B. Perkins, G. E. Potter, Lewis Radcliffe, Ed. C. Raney, H. C.

Raven, Earl D. Reid, Willis H. Rich, J. H. Riley, Wm. C. Schroeder, Hilda Schmaltz, Waldo L. Schmitt, L. P. Schultz, Leo Shapovalov, Smithsonian Institution, Stewart Springer, Williard F. Stanley, L. Stejneger, Frederick H. Stoye, F. B. Sumner, C. M. Tarzwell, W. F. Thompson, Chas. H. Townsend, Lawrence D. Townsend, F. M. Uhler, A. D. Welander, A. Wetmore, A. H. Wright, Stillman Wright, Gordon Gunter.

In addition, the gifts from two anonymous contributors are greatly appreciated.

New York Aquarium

IT HAS been a distinct shock to learn of the closing, on October 1, of THE NEW YORK AQUARIUM. From newspaper reports, it appears that New York Park Commissioner Robert Moses has ordered the demolition of the building to make way for construction of a new subway through Battery Park. Castle Clinton, or The Battery, as the aquarium building used to be called, was built in 1811 as an 18-gun fort to protect the city, and was utilized by the military until 1822. In 1824 it became Castle Garden, the most famous eating and entertainment place of the city. In it were entertained the Marquis de Lafayette in 1824, President Jackson in 1832, President Tyler in 1843, and Edward VII, then Prince of Wales, in 1860. P. T. Barnum staged the first American concert of Jenny Lind there in 1850. In 1896 the building opened as a free Aquarium, under the direction of the New York Zoological Society, and since that time it has become known throughout the world as one of the greatest of public aquariums. Annual attendance has of recent years been in the neighborhood of 2,500,000.

The living exhibits of the Aquarium have mostly been transferred to the Boston and Philadelphia Aquariums, since announced plans for a new aquarium, either in Bronx Park or at Coney Island, appear to be still nebulous. The Director, DR. C. M. BREDER, JR., the Aquarist, MR. C. W. COATES, the Pathologist, DR. ROSS NIGRELLI, associate DR. MYRON GORDON, and certain members of the operating staff have been retained and are still carrying on in the old building. They have been assigned to the Bronx Zoo, but their tenure is not yet clarified.

Many civic and historical organizations made strenuous attempts to save the building and exhibits, backed by statements of the subway engineers that the construction work would pass at least 150 feet from the building, and need not cause its closing. In the continued absence of any definite moves to construct a new building, and of any stated plan to retain the technical staff permanently, it is feared that the fine scientific work of Dr. Breder and his staff may be stopped completely. No public aquarium in the world has built up a scientific prestige comparable to that of "The Battery" and we would point out that the city government and the Zoological Society will suffer universal scientific condemnation if this phase of the Aquarium's work is forgotten.

News Notes

THE new IMPERIAL MUSEUM FOR NATURAL RESOURCES of Japan was opened early in September. PROFESSOR YAICHIRO OKADA is Director and DR. KATSUZO KURONUMA is Ichthyologist.

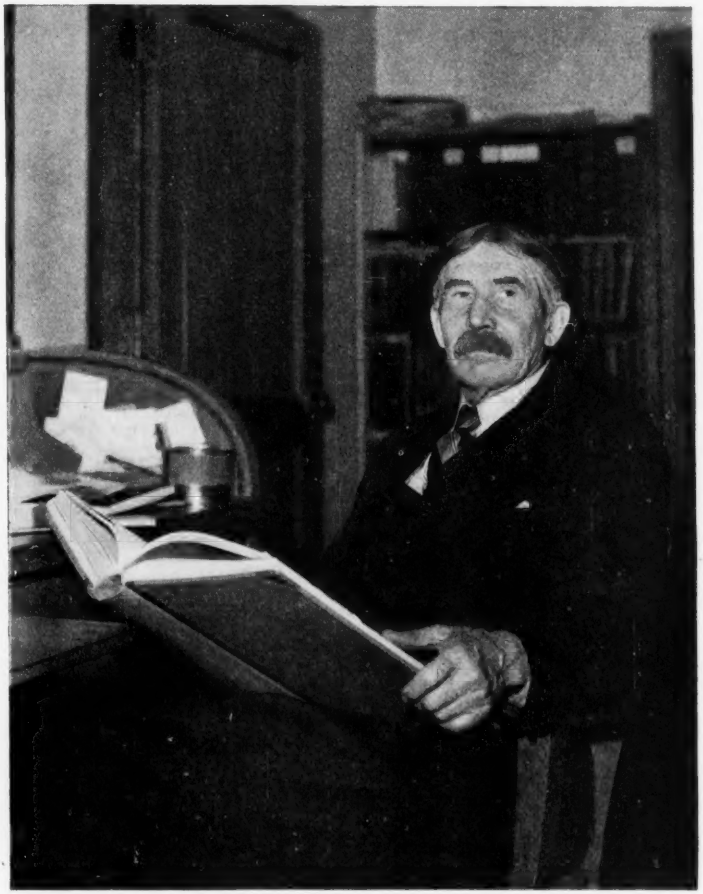
DR. JAMES OLIVER has joined the staff of the Department of Zoology, Northern State College of Education, Marquette, Michigan.

Howard Walton Clark

HOWARD WALTON CLARK, Curator of Fishes in the California Academy of Sciences, died in San Francisco on August 10, 1941. Mr. Clark was born in Allen County, Indiana, September 9, 1870. He graduated from Indiana University in 1896 and obtained his master's degree there in 1901, after which he acted as preparator in the Field Museum for three years. In 1904 began a long association with the Bureau of Fisheries, a large part of his time being spent as personal assistant to B. W. Evermann and as biologist at the Fairport, Iowa laboratory. In 1923 he followed Evermann to the California Academy, where he acted as aquarist, and later (1925–33) as assistant curator of fishes. In 1933 he was made curator of fishes, a post he held until his death.

Although a large part of his life was spent in studies of pearly freshwater mussels and of fishes, Clark's early training was in botany and he was always an enthusiastic gardener and apiculturist. His most important work was concerned with the plankton of Lakes Atitlan and Awatitlan, Guatemala, the biology of fresh-water mussels, a biological survey of Lake Maxinkuckee undertaken jointly with Evermann, and the Jordan, Evermann,

and Clark check-list of North American fishes. At the Academy, subsequent to Evermann's death, Clark published a number of shorter papers on fishes, largely resulting from his trip to the Galapagos Islands on Mr. Templeton Crocker's yacht "Zaca," and much of his time was spent in straightening out and cataloging the Academy's large fish collections.



Personally, Clark was exceedingly friendly and was always cooperative with his ichthyological colleagues. He always had a stock of stories to tell, or fruit to give one, or plants or bees to show. A Hoosier to the last, anyone from Indiana always received his especial attention, and his many friends in all parts of the country will mourn his passing.

INDEX TO SCIENTIFIC NAMES
1941, Nos. 1-4

New names and their principal references are printed in bold face type.

COPEIA IS THE JOURNAL OF THE AMERICAN SOCIETY OF ICHTHYOLOGISTS AND HERPETOLOGISTS

Officers

Honorary Presidents—LEONHARD STEJNEGER (Herpetology), U. S. National Museum, Washington, D. C., and JOHN TREADWELL NICHOLS (Ichthyology), American Museum, New York City.

President—JOHN R. DYMOND, Royal Ontario Museum of Zoology, Toronto, Ontario.

Vice-Presidents—WILLIAM J. K. HARKNESS, University of Toronto, Toronto, Ontario; F. H. STOYE, Mill Pond Road, Sayville, Long Island, New York; CHARLES M. BOGERT, American Museum, New York City.

Treasurer—ARTHUR W. HENN, Carnegie Museum, Pittsburgh, Pennsylvania.

Secretary—M. GRAHAM NETTING, Carnegie Museum, Pittsburgh, Pennsylvania.

Editors—Editor-in-Chief, HELEN T. GAIGE, Museum of Zoology, University of Michigan, Ann Arbor, Michigan; Ichthyological Editor, LIONEL A. WALFORD, Jordan Hall, Stanford University, California; Herpetological Editor, KARL P. SCHMIDT, Field Museum, Chicago, Illinois.

Historian—WALTER J. NECKER, Chicago Academy of Sciences, Chicago, Illinois.

Officers of Western Division

President—MARGARET H. STOREY, Stanford University, California.

Vice-President—A. M. WOODBURY, University of Utah, Salt Lake City, Utah.

Secretary—RICHARD S. CROKER, California State Fisheries Laboratory, Terminal Island, California.

Honorary Foreign Members

DAVID M. S. WATSON; LEO S. BERG; W. WOLTERSTORFF; SIR ARTHUR SMITH-WOODWARD; STANLEY S. FLOWER; C. TATE REGAN; F. WALL; L. D. BRONGERSMA; GEORG DUNCKER; ROBERT MERTENS; J. R. NORMAN; H. W. PARKER; JACQUES PELLEGRIN; P. J. SCHMIDT; MALCOLM SMITH.

Back numbers of COPEIA, all yet available, may be procured through the Secretary. Prices will be furnished on application.

Subscription, $3.00 per annum, 75c a copy.

Dues to Society, $3.00 per annum, including subscription to COPEIA.

Life Membership, $75.00, payable in one sum or three annual payments.

Dues and subscriptions are payable to the Society, through the Secretary.

Members should notify the Secretary immediately of any change in address.

Manuscripts, news items, and all correspondence regarding the Journal, should be addressed to one of the Editors.

Manuscripts should be submitted on good paper, as original typewritten copy, double-spaced, carefully corrected. Galley proof will be furnished authors.

Original contributions, not to be published elsewhere, are alone acceptable.

Reprints are furnished at approximate cost.

Figures, author's corrections, expensive tabular matter and unusually long articles may be charged in whole or in part to the author, at the discretion of the Editors.


ΙΧΘΤΣ
ΒΑΤΡΑΧΟΣ
ΕΡΠΕΤΟΝ

C37